EVERY BOY'S ARITHMETIC.

THE

INTELLECTUAL CALCULATOR,

OR

MANUAL OF PRACTICAL ARITHMETIC:

COMPREHENDING

WITH ALL THE USUAL RULES

A MUCH LARGER NUMBER OF BUSINESS QUESTIONS ON EACH ELEMENTARY RULE THAN HAS BEEN EVER BEFORE PUBLISHED;

AND

A Complete Course of Mental Arithmetic,

REDUCED FOR THE FIRST TIME TO A SYSTEM,

EMBRACING ALL THE

ARITHMETICAL REQUISITES OF THE SCHOOL, THE COUNTING-HOUSE, AND THE SHOP.

BY JOHN THOMAS CROSSLEY,

Joint Author of "Daily Lesson Books," &c., &c.;

AND

WILLIAM MARTIN,

Author of "The Educator," "Educational Magazine,"

"ILLUSTRATED NATURAL PHILOSOPHY," ETC., ETC.

EIGHTY-SEVENTH EDITION.

LONDON:

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AND SOLD BY
CURRY AND CO., DUBLIN; AND ALL BOOKSELLERS.

1866(?)

H. E. Powell.
October. 4th 1876.

1866(?)

THE KEY

Contains the Solutions of nearly 2400 Questions, shows the exact Mental process pursued in solving the Questions under the head "Mental Arithmetic," and explains the Fractograph.

Entered at Stationers' Hall.

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Table 1.

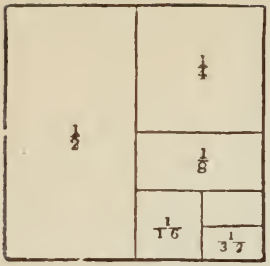
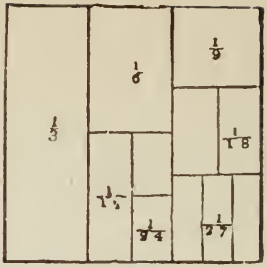


Table 2.



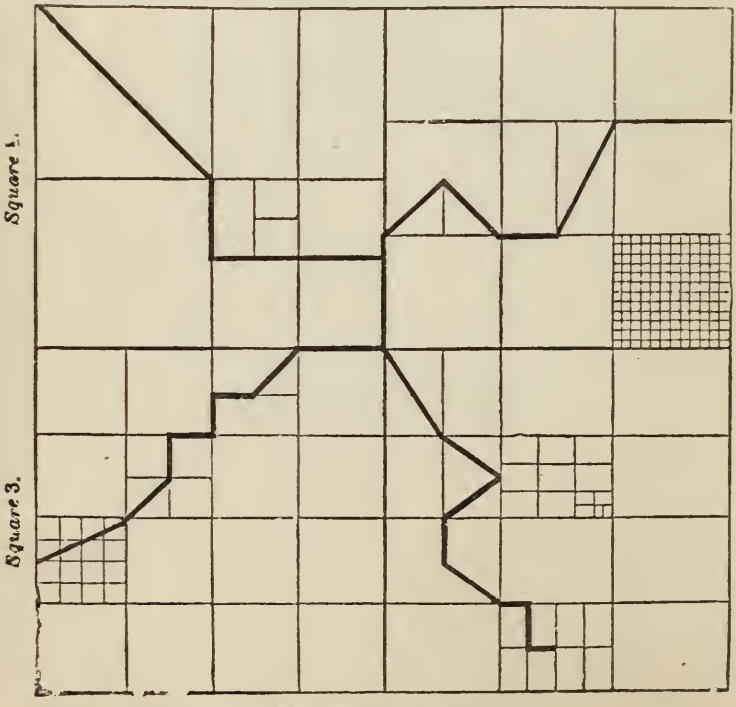
FRACTOGRAPH,

AN ILLUSTRATION OF FRACTIONAL PARTS OF

Money, Space, Weight, and Measure,

AND

AN AMUSING EXERCISE.



See Pages 145 *and* 146.

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PREFACE.

THE Authors of the INTELLECTUAL CALCULATOR, in presenting another Edition to the public, cannot refrain from expressing their satisfaction at the patronage the first has received, evidenced by a rapidity of sale almost unprecedented, as it affords testimony that intellectual expositions of the principles of arithmetical science are beginning to be appreciated, and that the old and formal methods will very shortly be exploded.

In this Edition the Authors have spared neither labour, time, nor expense to render the work in every way complete, and to make it what its name imports, an intellectual book, in which the rationale of the science should be demonstrated in a manner calculated to draw forth the *thinking* powers of a *child*. In doing this, their object has been to combine clearness with perspicuity, shortness with despatch. They have kept in view the market, the counting-house, and the shop. The elementary rules have been made highly interesting by a series of practical questions, of which a larger number will be found than in any preceding work on the subject, while they have shortened and simplified the more abstruse and difficult rules, particularly Proportion, Compound Proportion, and Fractions, which are rendered particularly clear and easy to be understood. The latter rule is exemplified and illustrated by a new invention, which shows at one view the nature of any kind of fraction, its proportions, the mode of calculating them, and the *reason* or *necessity* for the various rules by which fractions are worked and computed.

In addition to these important objects, and with a view still further to draw out the thinking faculty, the Authors have introduced a complete Course of Mental Arithmetic, which has been reduced, for the first time, to a regular system. This includes not only every variety of mental calculation hitherto employed, but much that is entirely new, all of which is of the highest importance to the various kinds of business in which readiness and despatch are required.

It has been common for teachers of Mental Arithmetic to use *particular* numbers and *particular combinations* of numbers, which, consequently, were of but very limited use; but in the system here laid down, short processes for quickly obtaining the answers to all such arithmetical propositions as are common in the avocations of life will be found, the object of the Authors being to bring every portion of their work to the test of

UTILITY.

ARITHMETIC.

Arithmetic is the science of computing by numbers. Numbers are represented by certain signs called figures.

The figures now used are

1 2 3 4 5 6 7 8 9 and 0.

There are six principal or fundamental Rules in Arithmetic: they are—

1. *Numeration,* which teaches to read numbers.
2. *Notation,* which teaches to write them down correctly.
3. *Addition,* which teaches to add numbers together.
4. *Subtraction,* which teaches to take one number from another.
5. *Multiplication,* which is a short method of adding numbers together.
6. *Division,* which teaches to separate numbers into equal parts.

The following Signs show the Relations of Numbers.

\+ Plus, or more, signifies Addition, as 6+6 equal 12.
— Minus, or less, signifies Subtraction, as 8 — 1 equal 7.
× Multiplied by, signifies Multiplication, as 4×2 equal 8.
÷ Divided by, signifies Division, as 10÷2 equal 5.
= Equal to, as 4+6=10.
: Is to.
:: So is. } As 1 : 2 :: 3 : 6.
: To.
√ Extraction of square root, as √9=3.

£. *s. d. q.*, signifying Pounds, Shillings, Pence, and Farthings, are the initials of the Latin words Libræ, Solidi, Denarii, and Quadrantes.

Roman Numerals.

I. = 1	X. = 10	C. = 100	M. = 1000
V. = 5	L. = 50	D. = 500	$\overline{M}$. = 1,000,000

MDCCCLVIII. = 1858.

NUMERATION

Is of great importance in arithmetic, as without it we should not be able to understand the value of figures after we had made them. Numbers commence at unity, or one, and increase by the addition of one. this is their absolute or independent value. They have also a relative value, increasing in the ratio of ten, according to the order in which they stand: for example, 6 by itself stands for six ones; but if it be in the second place in a line of figures, it stands for sixty: if in the third place, it stands for six hundred.

NUMERATION TABLES.

Table 1

Teaches the relative value of the nine digits.

							Units	1
						Tens	1	2
					Hundreds	1	2	3
				Thousands	1	2	3	4
			Tens of Thousands	1	2	3	4	5
		Hundreds of Thousands	1	2	3	4	5	6
		Millions	1	2	3	4	5	6	7
	Tens of Millions	1	2	3	4	5	6	7	8
Hundreds of Millions	1	2	3	4	5	6	7	8	9

Table 2

Teaches the value of noughts (0) *or cyphers.*

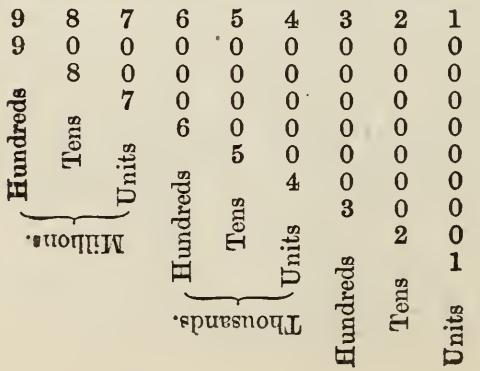

TABLE 3

Teaches the value of digits and cyphers combined.

								7
							9	0
						5	0	7
					6	0	0	0
				8	0	2	0	1
			1	0	1	0	1	0
		5	0	0	6	5	0	0
	2	0	7	0	0	0	3	0
4	0	7	0	6	0	9	0	8

Note.—Let the pupil be taught first simply to numerate from the first table, units one,—units, tens, twelve, &c.: then from the bottom of the second, units one,—units, tens, twenty, pointing out the relative place of each figure when brought down in place of noughts: lastly, let him write opposite the other table the value of each line of figures in words.

Write in words the following numbers:—

8 17 52 365 9845 10,000 14,207

3009 20,050 3,000,404 60,070,010

700,007 9,500,305 500,020,370

NOTATION

TEACHES TO WRITE DOWN NUMBERS CORRECTLY.

RULE.—Set down the number of units first. If no units be mentioned, put down a 0 in the units' place, and so of each of the other places, as shown in TABLE 2.

Example.—Write in figures fifty-two;—three hundred and sixty-five;—four hundred and four;—one thousand eight hundred and thirty;—eight thousand and forty;—ten thousand six hundred and six;—two millions, forty thousand, and ninety-seven;—a thousand thousand;—twelve thousand, twelve hundred and twelve.

EXTENDED NUMERATION EXERCISE.

Trillions.			Billions.			Millions.						
2;	5	7	6,	3	4	8;	2	7	9,	5	3	2;	0	6	4,	7	5	2.

ADDITION AND SUBTRACTION TABLE.

2 and 2 are 4	4 and 6 are 10	7 and 7 are 14
2 - 3 - 5	4 - 7 - 11	7 - 8 - 15
2 - 4 - 6	4 - 8 - 12	7 - 9 - 16
2 - 5 - 7	4 - 9 - 13	7 - 10 - 17
2 - 6 - 8	4 - 10 - 14	7 - 11 - 18
2 - 7 - 9	4 - 11 - 15	7 - 12 - 19
2 - 8 - 10	4 - 12 - 16	
2 - 9 - 11		8 and 8 are 16
2 - 10 - 12		8 - 9 - 17
2 - 11 - 13	5 and 5 are 10	8 - 10 - 18
2 - 12 - 14	5 - 6 - 11	8 - 11 - 19
	5 - 7 - 12	8 - 12 - 20
3 and 3 are 6	5 - 8 - 13	
3 - 4 - 7	5 - 9 - 14	9 and 9 are 18
3 - 5 - 8	5 - 10 - 15	9 - 10 - 19
3 - 6 - 9	5 - 11 - 16	9 - 11 - 20
3 - 7 - 10	5 - 12 - 17	9 - 12 - 21
3 - 8 - 11		
3 - 9 - 12	6 and 6 are 12	10 and 10 are 20
3 - 10 - 13	6 - 7 - 13	10 - 11 - 21
3 - 11 - 14	6 - 8 - 14	10 - 12 - 22
3 - 12 - 15	6 - 9 - 15	
	6 - 10 - 16	11 and 11 are 22
4 and 4 are 8	6 - 11 - 17	11 - 12 - 23
4 - 5 - 9	6 - 12 - 18	
		12 and 12 are 24

SIMPLE ADDITION.

THIS RULE TEACHES TO FIND THE SUM TOTAL OF ANY SIMPLE NUMBERS.

RULE.—Add the units, or right hand figures, together; set down under them all above tens, and add or carry the tens, as ones, to the second line. Proceed in the same manner with the other lines.

Example.

6^{7}	8^{14}	2^{18}	4^{11}
	3^{6}	6^{16}	2^{7}
		4^{10}	1^{6}
	2^{3}	5^{6}	4
7	4	8	1

The unit line amounts to 11, which is 1 ten and 1 over; set down the one over at the bottom of the unit column, and carry the 1 ten to the second column. The second column, with the 1 ten added, makes 18; set down 8 and carry 1. The third column amounts to 14; set down 4 and carry 1. The fourth column, with the one carried, amounts to 7. The answer, or sum total, is therefore 7481.

Exercises.

9	8	18	5	74	1930
4	17	70	28	194	81
5	9	35	9	776	7720
36	68	17	112	23	284
18	34	280	14	388	3860
72	136	140	56	97	965
1056	15872	29696	11008	20992	38912
33792	3968	3712	2752	5248	9728
132	496	928	688	1312	2432
4224	31	116	172	328	304
67584	63488	87	88064	41984	1216
2112	124	464	129	164	99
264	31744	1856	344	41	77824
99	248	59392	22016	656	53
16896	1984	29	43	2624	152
33	7936	232	1376	83968	608
528	992	7424	5504	123	4864
8448	93	14848	44032	10496	19456
79872	12032	47104	48	6912	4224
9984	47	11776	98304	1728	67584
2496	96256	2944	6144	864	16896
624	6016	736	384	108	1056
156	376	184	24576	81	132
58	141	46	3072	55296	37
1248	188	368	192	27	95
98	1504	5888	144	3456	264
312	752	138	49152	432	8448
39936	48128	94208	1536	27648	33792
4992	3008	1472	12288	216	2112
19968	24064	23552	768	13824	528

The intelligent teacher will readily discover the mode of finding the answers to these questions; or see Key, page 6.

Questions in Simple Addition.

1. How many are 2 and 3, 7 and 4, 9 and 16, 28 and 138? *Ans.* 207.

2. How many are 8 and 6, and 9 and 17, and 26 and 18, and 34 and 236? *Ans.* 354.

3. Add together four thousand and twenty, three hundred and five, seventy, and fifteen. *Ans.* 4410.

4. A man walked 27 miles on Monday, 29 on Tuesday, 34 on Wednesday, 29 on Thursday, 50 on Friday, and rode 109 on Saturday; how many miles did he travel in the week? *Ans.* 278.

5. A grazier has in fold 247 sheep, grazing 4008, on the road to London 516, at Smithfield 1101, and at the butcher's for slaughter 310; how many has he in all? *Ans.* 6182.

6. A nurseryman has 2597 apple trees, 68 peach trees, 9407 damson trees, 100 chestnut trees, 549 pear trees, 242 apricot trees, 742 cherry trees, 147 filbert trees, and 16,552 fir trees; how many trees has he altogether? *Ans.* 30,404.

7. A farmer had 317 acres sown with wheat, 241 with rye, 176 with oats, 294 with barley, 37 with beans, 84 fallow, 691 in grain, and 1840 uncultivated; how many acres had he? *Ans.* 3680.

8. An old gentleman being asked his age, replied, I was 4 years old when I went to school, 10 years at school, 3 years at Eton, 5 years at Oxford, 10 years travelling, and I have been now 38 years in the church; what was his age? *Ans.* 70.

9. A butcher had a bullock which weighed 800 lbs., 2 sheep, one weighing 130 lbs., the other 98 lbs., 2 calves weighing 159 lbs. each, 3 pigs 137 lbs. each; what was the gross weight of the whole? *Ans.* 1757 lbs.

10. How many days are there in the twelve calendar months? *Ans.* 365.

11. A gentleman left 3200*l.* to his widow, 5000*l.* to his eldest son, 2000*l.* to his brother, 1225*l.* to his second son, and 759*l.* to his daughter; what was the whole amount left? *Ans.* 12,184*l.*

12. Add up the numeration table No. 1, the numeration table No. 2; also the table No. 3.

13. What is the amount of fifteen thousand, twelve hundred and forty-nine? *Ans.* 16,249.

14. Add together five hundred thousand, thirty thousand and thirty, seventeen thousand five hundred and five. *Ans.* 547,535.

15. Elijah prophesied 897 years before the birth of Christ; how long is it since to Christmas 1834? *Ans.* 2731.

16. What is the amount of the numbers on a clock? *Ans.* 78.

17. What is the united length of the following rivers: Wolga 2190, Danube 1833, Rhine 840, Don 980, Thames 215, Severn 350 Shannon 250, Tiber 150, and Trent 185? *Ans.* 6993 miles.

SIMPLE SUBTRACTION

TEACHES TO FIND THE DIFFERENCE BETWEEN TWO NUMBERS.

RULE.—Take the number in the units' place in the *lower* line from the units of the upper line, and set down the difference under it. Proceed in like manner with each of the other figures in turn. If the upper number should be *less* than the lower, add ten to the top figure, and subtract as before, taking care to add one to the next figure in the lower line.

Example.

From	42715
Take	8642
	34073 The difference or remainder.

2 from 5 leaves 3, set down 3 under the 2; 4 from 1 I cannot, add 10 to the 1, and say, 4 from 11 leaves 7; 1 carried to the next figure, 6, makes 7, take 7 from 7 leaves nothing, set down 0; 8 from 2 I cannot, borrow ten and add it to 2, and say 8 from 12 leaves 4, 1 from 4 leaves three.

Exercises.

(1) 72841083 1730072	(2) 68427082 7430473	(3) 52847329 735422
(4) 74837278 8764390	(5) 69284738 54273828	(6) 63742845 48273564
(7) 93784296 7842809	(8) 47683287 2847695	(9) 92847628 43684378
(10) 748369287 3008300	(11) 587284375 82746208	(12) 500080008 7000070
(13) 482967137 93988479	(14) 500870080 300900090	(15) 708432695 600830045
(16) 700568072 168372584	(17) 572684527 497385297	(18) 684273849 67942800

Questions in Simple Subtraction.

1. Take *on your slate* 2 from 7, 5 from 9, 9 from 27, 19 from 36, 20 from 40, 18 from 29, 28 from 112, 40 from 200, 7 from 1500.

2. If an apricot tree had 74 apricots on it, and the wind blew off two dozen, how many were left? *Ans.* 50.

3. A man had to travel 640 miles, and rode 240, how far was he then from the end of his journey? *Ans.* 400.

4. How old, in the year 1853, is one born in the year 1835? *Ans.* 18.

5. There are 225 boys in a school, of these only 87 write, how many are unable to write? *Ans.* 138.

6. How long is it since the revolution of 1688?

7. How long is it since the conquest of England by William the Norman, in 1066?

8. By how much did the age of Methuselah exceed that of Adam? *Ans.* 39.

9. A draper bought 7428 yards of cloth, and sold 3976 yards; how much has he on hand? *Ans.* 3452.

10. A boy had 375 nuts, he gave 75 to his brother, 19 to his sister, three score to his cousin, the monkey stole 85, and the squirrel eat 28; how many had he left? *Ans.* 108.

11. A merchant bought 5972 yards of silk, and sold 244 yards to one person, 81 to another, 312 to a third, 472 to a fourth, 1000 to a fifth, and made a present of 50 yards; how many yards had he left? *Ans.* 3813.

12. There are in the Old Testament 23,214 verses, and 7959 in the New; how many more verses in the former than the latter? *Ans.* 15,255.

13. The Old Testament contains 592,439 words, and the New 181,253; by how many do the words in the Old Testament exceed? *Ans.* 411,186.

14. What sum added to 53,804 will make a million? *Ans.* 946,196.

15. Two men start from the same place, one walks 39 miles the first day, the other rides 62 in the same direction; how far distant are they the first evening? *Ans.* 23 miles.

16. Take 12,000, 1200, and twice 12, from 20,000? *Ans.* 6776.

17. Herculaneum and Pompeii were destroyed in the year 79; how long since in the year 1833?

18. How long have bells been in use, invented in the year 420?

19. Two men received together at the Bank 49,850*l.*; one received 10,717*l.*, how much did the other have? *Ans.* 39,133*l.*

20. How many more feet than yards in a mile? *Ans.* 3520.

21. In 1362 the English language was first used in courts of justice, how long has it been in legal use?

MULTIPLICATION AND DIVISION TABLE.

Twice	3 times	4 times	5 times	7 times	9 times
2 are 4	5 are 15	8 are 32	12 are 60	8 are 56	10 are 90
3 - 6	6 - 18	9 - 36		9 - 63	11 - 99
4 - 8	7 - 21	10 - 40		10 - 70	12 - 108
5 - 10	8 - 24	11 - 44	6 times	11 - 77	
6 - 12	9 - 27	12 - 48	6 are 36	12 - 84	10 times
7 - 14	10 - 30		7 - 42		10 are 100
8 - 16	11 - 33		8 - 48	8 times	11 - 110
9 - 18	12 - 36	5 times	9 - 54	8 are 64	12 - 120
10 - 20		5 are 25	10 - 60	9 - 72	
11 - 22		6 - 30	11 - 66	10 - 80	11 times
12 - 24	4 times	7 - 35	12 - 72	11 - 88	11 are 121
	4 are 16	8 - 40		12 - 96	12 - 132
3 times	5 - 20	9 - 45			
3 are 9	6 - 24	10 - 50	7 times	9 times	12 times
4 - 12	7 - 28	11 - 55	7 are 49	9 are 81	12 are 144

SIMPLE MULTIPLICATION

TEACHES TO FIND THE AMOUNT OF A NUMBER ADDED TOGETHER ANY NUMBER OF TIMES.

RULE.—Multiply every figure in the top line by the unit of the lower line; set down under each figure all above tens, and add 1 for each ten to the amount of the next figure.

Example.

83407 Multiplicand.
5 Multiplier.

417035 Product.

Seven multiplied by five makes 35, which is three tens and 5 over; set down the 5, and say 5 times nought is nothing, and 3 added makes 3, set down 3; 5 times 4 make 20, set down a 0 under the 4 and carry 2; 5 times 3 are 15, and 2 added make 17, set down 7 and carry 1; 5 times 8 make 40, and 1 carried are 41, set down 41.

Exercises.

Multiply		Multiply	
(1) 4875206643	by 2	(2) 2883901431	by 3
(3) 1737009373	by 4	(4) 1497260259	by 5
(5) 1581250272	by 6	(6) 61205243613	by 7

(7)	1219252041 by 8	(8)	1048006862 by 9
(9)	846391527 by 10	(10)	861106185 by 11
(11)	817553811 by 12	(12)	3271945536 by 2
(13)	2831238684 by 3	(14)	1923870078 by 4
(15)	1389634609 by 5	(16)	1139958354 by 6
(17)	1213373151 by 7	(18)	1234325439 by 8

EXTENDED MULTIPLICATION AND DIVISION TABLE.

1	2	3	4	5	6	7	8	9
13	26	39	52	65	78	91	104	117
14	28	42	56	70	84	98	112	126
15	30	45	60	75	90	105	120	135
16	32	48	64	80	96	112	128	144
17	34	51	68	85	102	119	136	153
18	36	54	72	90	108	126	144	162
19	38	57	76	95	114	133	152	171
20	40	60	80	100	120	140	160	180

Case 2.—When the multiplier is above 12 and under 20, multiply by the enlarged Table, performing the operation in one line.

Example.

2894
18

52092

18 times 4 are 72, set down 2 and carry 7; 18 times 9 are 162, and 7 are 169, set down 9 and carry 16; 18 times 8 are 144, and 16 are 160, set down 0 and carry 16; 18 times 2 are 36, and 16 are 52, set down 52.

Exercises.

572810 by 13	348297 by 15	185403 by 17
472801 by 14	284162 by 16	300462 by 19

Case 3.—If the number be above 20 and be found in the Multiplication Table, multiply by each of the two numbers which make it.

Example: 4152 multiplied by 72 is found by multiplying 4152 by 6 and that product by 12, because 6 times 12 make 72. 8 and 9 would produce the same result, because 8 times 9 are 72.

Exercises.

847208 by 24	7360124 by 28	74208452 by 132
452901 by 48	37284631 by 96	50070841 by 144

Case 4.—When the multiplier is above 20, and not the product of any two numbers under 12, multiply by the unit figure of the multiplier, as in Case 1, then multiply by the figure which stands next to the unit, and so with each in succession, taking care to place the first figure in each line under the figure by which you multiply.

Example. 5241 by 375

375

26205
36687
15723

1965375

Exercises.

36208475 by 1324	7296082 by 7007	428453762 by 1000
4729804 by 7845	472416 by 5050	9003000 by 45000

QUESTIONS IN SIMPLE MULTIPLICATION.

1. How many nuts must I have, to give 3 boys 3 each? *Ans.* 9.

2. If 20 boys have five marbles each, how many have they together? *Ans.* 100.

3. How many buttons on the coats of 1000 men, supposing there are 12 on each coat? How many on 10,000, on 57, on 636? *Ansrs.* 12,000.—120,000.—684.—7632

4. There are 8766 hours in a year, how many are there in 5, in 11, in 48, and in 100 years?

Ansrs. 43,830.—96,426.—420,768.—876,600.

5. How many hours has a boy lived who is ten years old?

Ans. 87,660

6. What difference is there between six dozen dozen and half dozen dozen? *Ans.* 792.

7. A woman spins 3742 yards of worsted per day, how many can she spin in a week, in a month of 26 days, in a year?
Ansrs. 22,452.—97,292.—1,171,246.

8. What is the difference between 25 times 42 and the square of 30; that is, 30 multiplied by 30? *Ans.* 150.

9. If the 125th part of a number be 4162, what is the number?
Ans. 520,250.

10. If an army consisted of 32 regiments of foot of 595 men each and ten regiments of horse of 462 men each, how many men were there in the army? *Ans.* 23,660.

11. If a man drink four pints of beer in a day, how many would he drink in a year? How many would he drink in 50 years? And how many penny pieces would be required to pay for it at twopence per pint? *Ansrs.* 1460 —73,000.—146,000.

12. How many loaves in 32 waggons, each containing 425 loaves?
Ans. 13,600.

13. What is the amount of a thousand thousands? *Ans.* 1,000,000.

14. What is the difference between fifteen times forty-five and fifteen times five and forty? *Ans.* 560.

15. How many times will a person's pulse beat in a week, or 168 hours, if it beat 3824 times in an hour? *Ans.* 642,432.

16. Each man of a ship of war, containing 480 men, had 42*l.* prize money; what was the sum divided among them?
Ans. 20,160*l.*

17. How many letters in 12 books, each book containing 360 pages, each page 36 lines, and each line 36 letters? *Ans.* 5,598,720.

18. There are 19 provinces in China, each having on the average 8,945,327 persons; what is the whole population?
Ans. 169,961,213.

19. What time is gained by a person who rises at 5 o'clock in the morning, instead of 8, during a life of 80 years, reckoning 365 days to each year? *Ans.* 87,600 hours.

20. A person laid by 1*l.* per week; what did he save in 15 years?
Ans. 780*l.*

21. Three merchants went into partnership at 25 years old; each gained 1050*l.* per year; they dissolved partnership at the age of 50; what was the amount gained by each, and by all?
Ansrs. 26,250*l.*—All, 78,750*l.*

22. There are 6721 houses in a town; 256 of these have 6 chimneys each, 946 have 5 each, 1002 have 4 each, 2174 have 3 each, 1765 have two each, 578 have 1 each; what is the number of chimneys in the town? *Ans.* 20,904.

SIMPLE DIVISION

TEACHES TO FIND HOW MANY TIMES ONE NUMBER IS CONTAINED IN ANOTHER NUMBER.

RULE.—Find how many times the divisor is contained in the first figure of the dividend, and put the figure answering to the number of times under it, as the first figure in the quotient; if there be any remainder, it should be carried, as so many tens, and added to the next figure, and the amount divided as before. Proceed in the same way to the last figure of the dividend. If the divisor is not contained in the first figure of the dividend, take the first two figures.

Example.

Dividend
Divisor 5) 128205

25641 Quotient.

The divisor 5 is not contained in the first figure 1, but it is contained in the 12 twice, therefore set down 2 under the 2, and carry the two over, as two tens, to the next figure, 8; 5 in 28 is contained 5 times and three over, set down 5 under the 8 and carry 30; 30 and 2 are 32, 5 in 32 is contained 6 times and 2 over; 5 in 20 is 4 times; 5 in 5 once.

Exercises.

2) 843784589	3) 287084287	3) 107528425
4) 845786295	5) 728438475	5) 827468000
6) 480007024	7) 324082764	7) 357284625
8) 472864295	9) 376820695	9) 472863784
10) 732000745	12) 457296843	11) 147296047
12) 584279384	14) 768472684	15) 300000000
16) 417362915	17) 372643571	18) 203040506
19) 310847205	19) 125340871	19) 100845000

LONG DIVISION.

When the divisor is above 20, the operation is called Long Division.

RULE.—Write down the dividend. Draw a curved line at each end of it. Place the divisor to the left hand of the first curve, reserving the space beyond the second curve for the quotient.

Observe how many of the first figures in the dividend must be taken before you have a number equal to your divisor. Find how many times the divisor is contained in the figures which you noted, and put the number in the space kept for the quotient. Multiply the divisor by the number in the quotient, and place the product under the figures noted in the dividend. Subtract the product. Bring down the next figure in the dividend, and find how many times the divisor is contained in this last formed line. Place the number in the quotient, and multiply the divisor by it as before. Subtract and bring down the next figure, and thus proceed till all are brought down. If the remainder, with a figure brought down, is not equal to the divisor, put a nought in the quotient and bring down the next figure.

Ex. 425) 1360726 (3201
1275
857
850
726
425
301 remainder.

In this question the first four figures must be taken, because 136 are not equal to the divisor. 425 in 1360 will be contained 3 times; put 3 in the quotient's place and multiply the divisor 425 by 3, which gives 1275. 1275 subtracted from 1360 leaves 85; the next figure 7 being brought down makes it 857. 857 contains 425 twice, therefore set down 2 in the quotient, and multiply the divisor by 2. Twice 425 is 850, which subtracted from 857 leaves 7; bring down the 2, which makes 72. 425 in 72 none, therefore put a nought in the quotient and bring down the next figure 6. 425 in 726 once; put one in the quotient and subtract 425 from 726, which leaves a remainder of 301. 425 contained in 1360726 is therefore 3201 times, and 301 remainder.

Exercises.

Divide		Divide	
(1) 34872504	by 14	(2) 72084767	by 14
(3) 84327106	by 15	(4) 52814007	by 16
(5) 30097208	by 18	(6) 57004327	by 18
(7) 30402079	by 28	(8) 17002947	by 45
(9) 64702853	by 72	(10) 700805306	by 96
(11) 537047294	by 132	(12) 745007071	by 144
(13) 870024865	by 1324	(14) 647208345	by 7854
(15) 470083275	by 7007	(16) 738450029	by 5050
(17) 800762809	by 1000	(18) 537284120	by 45000

Note 1.—The first twelve sums are to be performed by simple division, by taking the two numbers, which multiplied together will produce the divisor; as 14 is equal to 2×7; if therefore I divide by 2 and by 7, the result is equal to dividing by 14.

Note 2.—To show the value of remainders in dividing by component parts, the first six sums are to be done again by dividing in one line according to the enlarged table: as 14 in 34, &c.

Questions in Simple Division.

1. Divide sixpence among 3 boys, how much to each? A shilling among 4 boys? 24 apples among 6 boys? 84 among 7? 96 among 8? 54 among 6? 27 among 9? 36 among 6? 144 among 12? 99 among 9? 132 among 11?

2. 742 divided among 12 boys? *Ans.* 61,—10 remainder.

3. If a boy had 60 plums to eat in ten minutes, how many must he eat per minute? *Ans.* 6.

4. If a man have to walk 12 miles in 3 hours, how many miles is that per hour? *Ans.* 4.

5. A ship sailed 842 miles in a week; what is that per day? *Ans.* 120,—2 remainder.

6. The earth travels at the rate of 68,000 miles an hour, what distance is that per minute? *Ans.* 1133,—20 remainder.

7. If a vessel contains 120 gallons of water, how long would it take to empty it by a pipe which discharges 8 gallons an hour? *Ans.* 15 hours.

8. The wheel of a coach turned round in 7 hours 53,130 times, how many times was that per hour? How many times in a quarter of an hour? How many times in a minute?

Ansrs. 7590.—1897 and 2 remainder.—126 and 7 remainder.

9. A boy had 47 pears; he kept 11 for himself and divided the remainder among 9 boys; how many to each? *Ans.* 4.

10. The inhabitants of London are carried by the daily revolution of the earth 15,120 miles per day; what is that per minute? *Ans.* 10 miles.

11. Hanover has 1,550,000 inhabitants on a territory of 11,125 square miles; how many persons to each mile? *Ans.* 139,—3625 over.

12. The Republic of San Marino has only 17 square miles, and a population of 7000; how many to each mile? *Ans.* 411,—13 over.

13. France has 32,000,000 of persons on 154,000 square miles; how many persons to each mile? *Ans.* 207,—122,000 over.

14. The annual consumption of coals in London is 1,558,810 tons; what is that per day? *Ans.* 4270,—260 over.

15. In 1827 were exported 29,475,690 lbs. of coffee; what did it average per month? *Ans.* 2,456,307,—6 over.

16. What is the difference between the thousandth part of a million, and the 25th part of 20,000? *Ans.* 200.

17. How many days will a man be going to Edinburgh, which is 400 miles distant, if he walk on an average 27 miles a day? *Ans.* 14,—22 over.

18. Suppose a ship could sail direct round the world in 3 years, at what rate must she travel per day, the distance being 24,907 miles? *Ans.* 22 miles,—817 over.

19. What number is that which, multiplied by 217, will make the product 4,528,573? *Ans.* 20,869.

20. It took a million and a half of bricks to build a wall of a mile in length; how many was that per yard, the mile being 1760 yards? *Ans.* 852,—480 over.

21. At a celebrated battle the fourth part of a thousand thousand shots were fired; if one shot in 54 killed, how many were slain? *Ans.* 4629.

22. Europe contains 2,793,000 square miles, and 227,000,000 of inhabitants; how many persons to a square mile? *Ans.* 81.

23. The national debt is computed to be eight hundred millions, and the population of the United Kingdom 25 millions; what sum from each person would pay the whole debt? *Ans.* 32*l*.

ADDITION OF MONEY TABLE.

Pence	£	s.	d.	Pence	£	s.	d.	Pence	£	s.	d.
12	0	1	0	80	0	6	8	140	0	11	8
20	0	1	8	84	0	7	0	144	0	12	0
24	0	2	0	90	0	7	6	150	0	12	6
30	0	2	6	96	0	8	0	156	0	13	0
36	0	3	0	100	0	8	4	160	0	13	4
40	0	3	4	108	0	9	0	170	0	14	2
48	0	4	0	110	0	9	2	180	0	15	0
50	0	4	2	120	0	10	0	190	0	15	10
60	0	5	0	130	0	10	10	200	0	16	8
70	0	5	10	132	0	11	0	240	1	0	0
72	0	6	0	138	0	11	6	250	1	0	10

Addition of Money

Teaches to add together several sums of money of different denominations.

Rule.—Place pounds under pounds, shillings under shillings, pence under pence, and farthings under farthings, and draw a line under the last row of figures.

Supposing I had to find the amount of these several sums, 7*l.* 16*s.* 4¼*d.*—3*l.* 19*s.* 10½*d.*—61*l.* 8*s.* 2¾*d.*, I should place them thus,

£	s.	d.
7	16	4¼
3	19	10½
61	8	2¾
73	4	5½

and should proceed as follows: 3 farthings and 2 farthings are 5, and 1 are 6; 6 farthings are equal to 1½*d.* I should put down the halfpenny under the farthings and carry 1 to the pence, and say, 1 carried to 2 are 3, and 10 are 13, and 4 are 17; 17 pence are equal to 1 shilling and 5 pence, set down the 5 under the pence and carry 1 to the shilling column; 1 carried and 8 are 9, and 9 are 18, and 6 are 24; then descending the column I should notice the tens and say,—and 10 make 34, and 10 make 44. 44 shillings equal 2 pounds 4 shillings; set down 4 under the shillings, and carry 2 to the pound column. 2 carried and 1 are 3 and 3 are 6, 6 and 7 are 13; set down 3 under 1 and carry 1 to the next column, as in Simple Addition. 1 carried and 6 are 7; set down 7. The amount of these sums of money will therefore be 73*l.* 4*s.* 5½*d.*

Exercises.

	£	s.	d.
(1)	8	4	$11\frac{3}{4}$
	16	0	$7\frac{1}{2}$
	20	9	$2\frac{1}{4}$
	14	5	$9\frac{3}{4}$
	31	8	11
	19	10	$8\frac{3}{4}$
	339	10	$7\frac{1}{2}$
	45	12	$0\frac{1}{2}$
	19	11	10
	67	11	$10\frac{1}{2}$
(31)	84	8	$1\frac{1}{2}$
	107	12	$6\frac{3}{4}$
	45	3	4
	196	3	$6\frac{3}{4}$
	103	4	$9\frac{1}{2}$
	186	3	$10\frac{1}{4}$
	81	18	0
	243	15	$6\frac{1}{4}$
	205	7	$11\frac{1}{2}$
	278	3	$2\frac{1}{4}$
(61)	445	11	$5\frac{1}{2}$
	474	8	9
	401	18	$0\frac{1}{4}$
	340	8	$4\frac{1}{2}$
	213	10	$10\frac{1}{2}$
	194	6	8
	221	8	$1\frac{1}{2}$
	485	6	$1\frac{1}{2}$
	191	18	$6\frac{1}{2}$
	264	1	4
(91)	556	6	$10\frac{1}{4}$
	458	6	$10\frac{1}{2}$
	723	7	$1\frac{1}{4}$
	810	3	6
	836	2	$6\frac{3}{4}$
	943	0	$8\frac{1}{2}$
	963	3	$2\frac{3}{4}$
	347	18	0
	836	16	0
	2808	18	0

	£	s.	d.
(11)	25	0	$2\frac{1}{2}$
	37	4	$9\frac{1}{2}$
	33	18	9
	47	16	$3\frac{3}{4}$
	31	6	$2\frac{1}{2}$
	27	6	$10\frac{1}{2}$
	62	10	8
	74	10	$8\frac{1}{4}$
	132	4	$1\frac{1}{2}$
	41	14	$0\frac{1}{4}$
(41)	90	4	2
	149	10	$5\frac{1}{4}$
	359	2	$10\frac{1}{2}$
	326	11	$6\frac{1}{4}$
	232	1	1
	342	15	$11\frac{1}{4}$
	89	18	$9\frac{1}{2}$
	390	5	11
	195	2	$11\frac{1}{2}$
	97	11	$5\frac{3}{4}$
(71)	521	1	$10\frac{1}{3}$
	189	7	$3\frac{1}{2}$
	533	4	$9\frac{1}{2}$
	564	6	0
	540	2	$5\frac{3}{4}$
	250	16	7
	619	2	$9\frac{3}{4}$
	733	19	1
	667	14	$8\frac{1}{4}$
	770	9	$10\frac{1}{2}$
(101)	2885	12	0
	1736	10	0
	7475	4	0
	3318	14	0
	7646	8	0
	72	0	0
	264	12	0
	853	0	0
	2962	1	0
	2893	19	0

	£	s.	d.
(21)	167	8	9
	59	7	$9\frac{3}{4}$
	144	1	$6\frac{1}{2}$
	180	3	$9\frac{1}{4}$
	376	1	0
	206	1	$10\frac{1}{2}$
	95	6	8
	38	1	$7\frac{1}{2}$
	43	5	1
	49	2	$11\frac{3}{4}$
(51)	107	9	$10\frac{1}{2}$
	193	9	$9\frac{1}{2}$
	288	3	0
	228	5	2
	177	9	$10\frac{3}{4}$
	156	9	$10\frac{1}{2}$
	39	1	$5\frac{1}{2}$
	437	10	0
	195	8	$0\frac{3}{4}$
	559	3	$1\frac{1}{2}$
(81)	801	7	$1\frac{1}{3}$
	399	1	8
	830	16	$9\frac{3}{4}$
	539	14	$11\frac{1}{2}$
	744	15	$0\frac{1}{2}$
	813	13	3
	884	12	$4\frac{3}{4}$
	848	16	$0\frac{1}{2}$
	753	7	$3\frac{3}{4}$
	433	19	0
(111)	2821	13	0
	5410	10	0
	7770	14	0
	2704	13	0
	209	0	0
	636	1	4
	320	11	8
	678	2	6
	1396	0	0
	3314	0	0

Exercises.

	£	s.	d.		£	s.	d.		£	s.	d.
(121)	255	7	$4\frac{1}{2}$	(131)	6008	19	$7\frac{1}{2}$	(141)	11522	0	0
	1152	13	4		4269	13	$1\frac{1}{2}$		19053	7	6
	1229	6	8		7620	0	0		2835	11	$0\frac{1}{4}$
	3657	13	$1\frac{1}{2}$		7113	15	$9\frac{1}{2}$		7572	11	$0\frac{3}{4}$
	5470	12	0		4842	1	$10\frac{1}{2}$		52889	5	0
	753	3	$1\frac{1}{2}$		7999	5	0		24716	0	10
	2562	4	$9\frac{3}{4}$		5399	9	$10\frac{1}{2}$		12339	3	4
	492	4	$9\frac{1}{4}$		9081	10	$4\frac{1}{4}$		60201	10	8
	4408	14	$6\frac{1}{2}$		8263	2	6		34754	3	4
	2311	14	$3\frac{3}{4}$		8968	12	$9\frac{3}{4}$		78636	14	$7\frac{1}{2}$

	£	s.	d.		£	s.	d.		£	s.	d.
(151)	46871	6	$10\frac{1}{2}$	(161)	0	18	$1\frac{3}{4}$	(171)	83	19	$1\frac{1}{2}$
	75328	2	6		3	9	$5\frac{3}{4}$		52	7	$7\frac{3}{4}$
	76425	16	$2\frac{1}{2}$		4	15	6		160	0	$6\frac{1}{2}$
	80793	16	$11\frac{3}{4}$		25	0	7		55	10	2
	36316	6	$9\frac{1}{2}$		69	5	$3\frac{3}{4}$		54	3	$2\frac{1}{4}$
	20312	5	0		6	11	$4\frac{1}{2}$		166	11	$11\frac{1}{4}$
	32774	3	$10\frac{1}{2}$		54	10	$3\frac{1}{2}$		32	10	$3\frac{1}{4}$
	61058	8	0		15	17	$4\frac{3}{4}$		72	11	$9\frac{3}{4}$
	51501	8	$7\frac{1}{2}$		64	10	8		9	2	$8\frac{1}{2}$
	13778	16	$9\frac{3}{4}$		4319	13	$1\frac{1}{2}$		79439	12	$11\frac{1}{4}$

Questions in Addition of Money.

1. A man lent another at different times, $6\frac{1}{2}d.$—$10\frac{1}{4}d.$—1*s.* $0\frac{1}{2}d.$—1*l.*—3 groats, and 2 seven-shilling pieces; how much did he lend him altogether? *Ans.* 1*l.* 17*s.* $5\frac{1}{4}d.$

2. A gentleman subscribed to 7 different charities; to the first he gave 3 groats, to the second 4 sixpences, to the third a crown, to the fourth half a guinea, to the fifth a guinea, to the sixth a guinea and a half, and to the seventh 100*l.*; what is the sum total of these? *Ans.* 103*l.* 11*s.* 0*d.*

3. I bought a parcel of goods which cost 148*l.* 7*s.* 4*d.*; for these was paid, packing 2*s.* 6*d.*, case 12*s.* 8*d.*, cord $10\frac{1}{2}d.$, porterage 2*s.*, freightage 3*l.* 11*s.* 6*d.*, carriage by waggon 15*s.*, booking 8*d.*; what do these goods stand me in? *Ans.* 153*l.* 12*s.* $6\frac{1}{2}d.$

4. The bills sent me in at Christmas were as follows: the grocer's 18*l.* 10*s.* 9*d.*, the baker's 11*l.* 11*s.* $11\frac{1}{2}d.$, the butcher's 20*l.* 5*s.* $7\frac{1}{2}d.$, the oilman's 2*l.* 4*s.* 10*d.*, the shoemaker's 10*l.* 6*s.* 4*d.*, the linendraper's 19*l.* 4*s.* 6*d.*, the ironmonger's 5*l.* 9*s.* 10*d.*, the greengrocer's 4*l.* 12*s.* 6*d.*, the confectioner's 15*l.* 6*s.* 3*d.*, the poulterer's 14*l.* 7*s.* 8*d.*; what was the amount? *Ans.* 122*l.* 0*s.* 3*d*

5. A gentleman paid his servants: butler 40*l.* 6*s.* 8*d.* for a year's salary, coachman 30*l.* 2*s* 6*d.*, steward 50*l.* 6*s.* 11*d.*, housekeeper 25*l.*, cook 20*l.* 9*s.* 6*d.*, 2 footmen 20*l.* each, 2 housemaids 12*l.* each, scullion 10*l.* 10*s.*, dairy-maid 8*l.*, porter 20*l.* 6*s.* 4*d.*; what sum of money did he require? *Ans.* 269*l.* 1*s.* 11*d.*

6. A merchant owes the following sums: at London 1074*l.* 10*s.*, at Liverpool 1856*l.* 16*s.* 8*d.*, at Paris 25,000*l.*, at Amsterdam 1500*l.*, at Dresden 18*l.* 7*s.* 11½*d.*, at Madrid 116*l.* 4*s.* 7¼*d.*, at Constantinople 11,000*l.* 6*s.* 5*d.*, at Lisbon 1444*l.* 7*s.* 10*d.*, at Tunis 64*l.* 0*s.* 8½*d.*, at Copenhagen 1211*l.* 0*s.* 0¾*d.*; what was the gross amount of his debts? *Ans.* 43,285*l.* 14*s.* 3*d.*

7. An old miser, being afraid of losing his money, hid the following sums and pieces of money in various parts of his premises under the floor 927 sovereigns and 3 crowns; in a closet 1425*l.* in bank notes; buried in the garden 184*l.* in half-crowns; and in a shed 15*l.* 18*s.* 4*d.* in copper; what was the whole amount? *Ans.* 2552*l.* 13*s.* 4*d.*

8. The rent of a nobleman's house is 2500*l.* per year, poor rates 400*l.* 12*s.* 7*d.*, water rate 84*l.* 10*s.* 9*d.*, church rate 48*l.* 10*s.* 9*d.*, Easter Offering 5*l.* 5*s.*, window tax 104*l.* 6*s.* 9*d.*, house tax 100*l.*, highway rate 81*l.* 7*s.* 4*d.*, pavement 16*l.* 10*s.* 6*d.*, watchman 2*l.* 5*s.* 6*d.*, scavenger 15*l.* 8*s.*, dog tax 15*l.* 10*s.* 9*d.*, servant tax 12*l.* 5*s.* 6*d.*, horse tax 50*l.* 6*s.* 8¼*d.*, hair powder 2*l.* 2*s.*, and incidentals 50*l.*; what is the annual expense of his establishment? *Ans.* 3489*l.* 2*s.* 1¼*d.*

9. Twelve children, of one family, saved up money during the year; the 1st 9*s.* 6*d.*, the 2nd 8*s.* 4*d.*, the 3rd 10*s.* 8*d.*, the 4th 16*s.* 6*d.*, the 5th 1*s.* 2¼*d.*, the 6th 7*s.* 8½*d.*, the 7th 1*s.* 9¼*d.*, the 8th 11*s.* 4¾*d.*, the 9th 2*s.* 6*d.*, the 10th 3*s.* 4¼*d.*, the 11th 10*s.* 7¼*d.*, the 12th 5*s.*; how much did the box contain in which these amounts were kept? *Ans.* 4*l.* 8*s.* 6¼*d.*

10. Four bags contained the following sums of money: the 1st 528 sovereigns, the 2nd 57*l.* 15*s.* 6*d.* in silver, the 3rd 19*l.* 3*s.* 7*d.* in pence, and the 4th 1*l.* 7*s.* 3¾*d.* in farthings; what was the value of the 4 bags? *Ans.* 606*l.* 6*s.* 4¾*d.*

11. The expenses of building a mansion were as follows; surveyor 250*l.*, bricklayer 4852*l.* 10*s.*, mason 2100*l.* 18*s.*, carpenter 3755*l.* 15*s.*, plumber 1180*l.* 17*s.* 6*d.*, glazier 575*l.* 13*s.* 4*d.*, painter 350*l.* 7*s.* 6*d.*, and paper-hanger 151*l.* 1*s.* 6*d.*; what was the amount? *Ans.* 13,217*l.* 2*s.* 10*d.*

12. What sum will pay the following bills: grocer, 25 lbs. of moist sugar, 13*s.* 6*d.*, 7 lbs. of loaf sugar, 7*s.* 3½*d.*, 17 lbs. of currants, 8*s.* 9*d.*; cheesemonger, 1 cheese of 36 lbs., 1*l.* 7*s.* 6*d.*, 12 lbs. of butter, 9*s.* 10*d.*; baker, 73 loaves, 2*l.* 7*s.* 0½*d.*? *Ans.* 5*l.* 13*s* 11*d.*

COMPOUND SUBTRACTION

IS THE METHOD OF FINDING THE DIFFERENCE OF TWO COMPOUND NUMBERS.

SUBTRACTION OF MONEY.

Arrange the different denominations so that they fall under each other, and take care to place the smaller amount in the lower line. Thus, suppose I had to take 16*l.* 5*s.* 10¼*d.* from 18*l.* 19*s.* 11½*d.*, I should place them thus :—

£	s.	d.
18	19	11½
16	5	10¼
2	14	1¼

and say, take a farthing from a halfpenny, remains a farthing; set down ¼ in the farthings' place. Take 10 from 11 remains 1 ; set 1 down in the pence. Take 5 from 19 remains 14 ; set down 14 in the shillings' place. Take 16 from 18 remains 2 ; set down 2 in the pounds' place. Thus the remainder will be 2*l.* 14*s.* 1¼*d.*

In the above sum each of the denominations placed below the other is less than the one above ; but it often happens that, though the entire lower line is less than the upper one, yet some of the lower denominations are greater than the upper ones, as in the following :—

£	s.	d.
19	1	4¼
18	18	10¾

In such cases, instead of always borrowing 1, as in simple subtraction, from the pence you borrow 4 farthings, or 1 penny ; from the shillings you borrow 12 pence, or 1 shilling ; from the pounds you borrow 20 shillings, or 1*l.* The reason why you say borrow 4 when you borrow 1 penny is because, as you have to add the 1 penny to the farthings, you must make farthings of it before you can do so, and the same of the shillings ; you borrow 1 shilling and call it 12 pence, because you must turn the shilling into pence before you can add it to them ; and so of the pounds. After having

borrowed in this manner, you must be careful always to add 1 to the next denomination—as for example:—

£	s.	d.
19	1	$4\frac{1}{4}$
18	18	$10\frac{3}{4}$
0	2	$5\frac{1}{2}$

Take 3 farthings from 1 I cannot, borrow 1 penny, which is 4 farthings, which added to 1 makes 5, take 3 from 5 remains 2; set down 2 in the farthings' place, and carry 1 to the 10, which is 11. Take 11 from 4 I cannot, borrow 1 shilling, or 12 pence, which added to the 4 makes it 16. Take 11 from 16 remains 5; set down 5 in the pence and carry 1 to the 18 shillings, which makes it 19. Take 19 from 1 you cannot, borrow 1*l.*, or 20 shillings, which added to the 1 makes it 21. Take 19 from 21 remains 2; set down 2 in the shillings, and carry 1 to the 18*l.*, which makes it 19*l.* Take 19 from 19 remains nothing. The answer therefore is 2 shillings and 5 pence halfpenny.

Exercises.

	£	s.	d.		£	s.	d.		£	s.	d.
(1)	287	3	4	(2)	574	16	$8\frac{1}{4}$	(3)	1247	10	$8\frac{1}{2}$
	124	2	2		347	12	$9\frac{1}{4}$		842	14	$9\frac{1}{4}$
(4)	6847	5	$8\frac{3}{4}$	(5)	7184	17	$7\frac{1}{4}$	(6)	5273	12	$9\frac{1}{4}$
	4729	12	$10\frac{1}{2}$		384	18	$7\frac{3}{4}$		4584	13	$10\frac{1}{2}$
(7)	7846	14	$9\frac{1}{4}$	(8)	6870	0	0	(9)	7070	17	$2\frac{1}{2}$
	520	0	$10\frac{1}{2}$		437	9	$4\frac{3}{4}$		5708	3	$3\frac{3}{4}$
(10)	17015	5	$9\frac{1}{2}$	(11)	98407	13	$6\frac{1}{2}$	(12)	75862	17	$9\frac{1}{4}$
	8004	13	$8\frac{3}{4}$		80008	14	$7\frac{3}{4}$		58379	18	$10\frac{1}{2}$
(13)	84692	11	$8\frac{1}{4}$	(14)	47395	14	$9\frac{1}{2}$	(15)	72804	13	$9\frac{1}{2}$
	75384	15	$10\frac{1}{2}$		38279	15	$10\frac{3}{4}$		47008	14	$11\frac{1}{2}$
(16)	38409	13	$11\frac{1}{2}$	(17)	84707	15	$1\frac{1}{2}$	(18)	70080	17	$3\frac{1}{2}$
	10009	14	$8\frac{1}{4}$		70847	15	$9\frac{3}{4}$		300	18	$5\frac{3}{4}$

Questions in Subtraction of Money.

1. Suppose Thomas Mercer was indebted to Robert Cooper 125*l.*, and paid him 79*l.*, what would he still owe him? *Ans.* 46*l.*

2. Suppose he owed him 102*l.* 19*s.* $4\frac{1}{2}$*d.*, and paid him 28*l.* 16*s.* 4*d.*, what would he have to pay? *Ans.* 74*l.* 3*s.* $0\frac{1}{2}$*d.*

3. A tradesman borrowed 1000*l.* and paid in the following manner: at Christmas 56*l.* 10*s.* 6*d.*, at Lady Day 102*l.* 10*s.* $9\frac{1}{4}$*d.*, at Midsummer 587*l.* 10*s.* $11\frac{1}{2}$*d.*, what had he to pay to make up the amount borrowed? *Ans.* 253*l.* 7*s.* $9\frac{1}{4}$*d.*

4. A ship foundered at sea, having on board specie to the amount of half a million of pounds sterling; of this was saved a chest containing 13,000 sovereigns, one holding 10,000 crowns, and one to the value of 25,000*l.* sterling; how much money was lost? *Ans.* 459,500*l.*

5. A horse and chaise were worth 75 guineas; the chaise being sold for 15*l.*, what was the value of the horse? *Ans.* 63*l.* 15*s.*

6. A waggon and team were worth 145*l.* 10*s.* Now if the 1st horse was worth 20*l.*, the 2nd 30*l.*, the 3rd 40*l.*, and the 4th 50*l.*, what was the worth of the waggon? *Ans.* 5*l.* 10*s*

7. A gentleman dying, left 20,000*l.* On this the following legacies were charged: to his daughter 2500*l.*, to his brother 500*l.*, to his 12 nephews 150*l.* each, to his 5 grandsons 25*l.* each, to public charities 187*l.* 10*s.* 6*d.*, to his 4 servants 5*l.* each, to his housekeeper 10 guineas; what amount fell to his eldest son and heir?

Ans. 14,856*l.* 19*s.* 6*d.*

8. A young man had 125*l.* 10*s.* 10*d.* in the savings' bank; being sick, he drew out 8*l.* 7*s.* 4*d.* His mother dying, he withdrew 10 guineas for her funeral. After this, he went into business, and laid out 40*l.* 7*s.* 6*d.* in stock, and paid 11*l.* 8*s.* 6*d.* for fixtures; what sum had he then remaining? *Ans.* 54*l.* 17*s.* 6*d.*

9. A gentleman obtained his annual income in the following manner; 500*l.* from the stocks, 240*l.* from rents of houses, 1160*l.* 10*s.* from rents of lands, 563 guineas from canal shares, 84*l.* 6*s.* 4*d.* from Columbian Bonds, and 684*l.* from the French funds. —He expended annually 80 guineas for house-rent, 40*l.* for servants, 250*l.* for housekeeping, 60*l.* for horse and chaise, 50*l.* for travelling, 20*l.* for clothes, and gave away 40*l.* among the poor. I demand his annual income and expenditure, and how much the former exceeded the latter?

Ansrs. 3259*l.* 19*s.* 4*d.*—544*l.*—2715*l.* 19*s.* 4*d*

10. Bought goods for 1845*l.* 10*s.* 8*d.*, sold them for 2155*l.* 12*s.*, what was the profit? *Ans.* 310*l.* 1*s.* 4*d.*

11. What is left of 5*l.* after buying linen 1*l.* 15*s.* 6*d.*; shoes 2*s.* 3*d.*; gloves 5*s.* 6*d.*; hat 18*s.*; and sundries 13*s.* 3½*d.*?

Ans. 15*s.* 5½*d.*

12. A man has due to him 425*l.* 16*s.* 8*d.*, 31*l.* 10*s.* 11*d.*, 487*l.* 13*s.* 3¼*d.*, and 27*l.* 3*s.* 5*d.*; he owes 153*l.* 7*s.* 10*d.*, 95*l.* 19*s.*, 127*l.* 4*s.* 6*d.*, and 5*l.* 19*s.* 6¾*d.*; what is the difference?

Ans. 589*l.* 13*s.* 4½*d.*

13. What is the difference between 21 guineas and two scores of sovereigns? *Ans.* 17*l.* 19*s.*

14. From 20,000*l.* take fifteen thousand, fifteen hundred, and fifteen pounds. *Ans.* 3485*l.*

ENLARGED MULTIPLICATION TABLE.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216	228	240
13	26	39	52	65	78	91	104	117	130	143	156	169	182	195	208	221	234	247	260
14	28	42	56	70	84	98	112	126	140	154	168	182	196	210	224	238	252	266	280
15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270	285	300
16	32	48	64	80	96	112	128	144	160	176	192	208	224	240	256	272	288	304	320
17	34	51	68	85	102	119	136	153	170	187	204	221	238	255	272	289	306	323	340
18	36	54	72	90	108	126	144	162	180	198	216	234	252	270	288	306	324	342	360
19	38	57	76	95	114	133	152	171	190	209	228	247	266	285	304	323	342	361	380
20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400

MULTIPLICATION OF MONEY

TEACHES HOW TO MULTIPLY ANY SUM OF MONEY BY ANY NUMBER.

Case 1.—When the multiplier does not exceed 12.

RULE.—Place the multiplier under the pence, and begin by multiplying the farthings by it: find how many pence are included in the number of farthings, and carry that number to the pence; put down the odd farthings under the farthings. Multiply the pence; add the number of pence carried from the farthings; find how many shillings are contained in the whole amount of pence: set down the odd pence under the pence and carry the number of shillings. Proceed in the same way with the shillings; and multiply the pounds as in simple multiplication.

	£	s.	d.
Example.	29	15	$10\frac{3}{4}$
			5
	148	19	$5\frac{3}{4}$

5 times $\frac{3}{4}$ are $3\frac{3}{4}d.$, set down $\frac{3}{4}$ and carry 3 to the pence; 5 times 10*d.* are 4*s.* 2*d.*, and 3*d.* carried are 4*s.* 5*d.*, set down 5 under the pence and carry 4; 5 times 15 are 75 and 4 carried are 79*s.*, equal to 3*l.* 19*s.*, set down 19 under the shillings and carry 3; 5 times 9 are 45 and 3 carried are 48, set down 8 and carry 4; 5 times 2 are 10 and 4 are 14, set down 14, which gives 148*l.* 19*s.* $5\frac{3}{4}d.$

QUESTIONS IN MULTIPLICATION OF MONEY.

			£	s.	d.
2	lbs. of butter at 6*d.* per lb.?	*Ans.*	0	1	0.
3	lbs. of sugar at 8*d.* per lb.?	*Ans.*	0	2	0.
8	lbs. of cheese at 5*d.* per lb.?	*Ans.*	0	3	4.
5	lbs. of tea at 7*s.* per lb.?	*Ans.*	1	15	0.
4	lbs. of coffee at 2*s.* 8*d.* per lb.?	*Ans.*	0	10	8.
6	gallons of rum at 12*s.* 6*d.* per gallon?	*Ans.*	3	15	0.
8	yards of gingham at 1*s.* $4\frac{1}{2}d.$ per yard?	*Ans.*	0	11	0.
10	lbs. of nutmegs at 7*s.* $6\frac{3}{4}d.$ per lb.?	*Ans.*	3	15	$7\frac{1}{2}$
11	cwts. of sugar at 3*l.* 17*s.* 6*d.* per cwt.?	*Ans.*	42	12	6.
12	bales of cotton at 8*l.* 19*s.* 6*d.* per bale?	*Ans.*	107	14	0.
7	hogsheads of porter at 17*l.* 4*s.* 9*d.* per hhd.	*Ans.*	120	13	3.
9	cwts. of currants at 25*l.* 17*s.* $10\frac{1}{2}d.$ per cwt.?	*Ans.*	233	0	$10\frac{1}{2}$.
11	bushels of wheat at 8*s.* $10\frac{1}{4}d.$ per bushel?	*Ans.*	4	17	$4\frac{1}{4}$.

By the Extended Multiplication Table.

Example. * 13 yards of velvet at 1*l.* 14*s.* 6½*d.* per yard?

£	s.	d.
1	14	6½
		13
22	9	0½

		£	s.	d.
14 yards of muslin at 1*l.* 15*s.* 8*d.* per yard?	*Ans.*	24	19	4.
13 hogsheads of beer at 4*l.* 12*s.* 5*d.* per hhd.?	*Ans.*	60	1	5.
15 ounces of silver at 4*s.* 10½*d.* per ounce?	*Ans.*	3	13	1½.
16 sacks of flour at 2*l.* 5*s.* 6d. per sack?	*Ans.*	36	8	0.
17 loads of hay at 4*l.* 11*s.* 3*d.* per load?	*Ans.*	77	11	3.
18 silk handkerchiefs at 5*s.* 9¼*d.* each?	*Ans.*	5	3	10½.
20 suits of clothes at 4*l.* 5*s.* 3*d.* each?	*Ans.*	85	5	0.

Case 2.—If the number be above 20, and found in the multiplication table, multiply by each of the two numbers which make it.

Example. 54 mirrors at 2*l.* 8*s.* 6*d.* each?

I see 54 in the multiplication table, and find that it is produced by multiplying together 6 and 9; I therefore multiply

		£	s.	d.
		2	8	6
	by			6
9 × 6=54		14	11	0
	and by			9
		130	19	0

		£	s.	d.
25 yards of lace at 4*s.* 6*d.* per yard?	*Ans.*	5	12	6.
40 yards of damask at 9*s.* 7½*d.* per yard?	*Ans.*	19	5	0.
56 stone of soap at 7*s.* 10¾*d.* per stone?	*Ans.*	22	2	2.
54 barrels of herrings at 15*s.* 9*d.* per barrel?	*Ans.*	42	10	6.
72 lbs. of candles at 8½*d.* per lb.?	*Ans.*	2	11	0.
64 lbs. of spice at 18*s.* 9¼*d.* per lb.	*Ans.*	60	1	4.

* The authors earnestly recommend that the pupils should, before this period, be perfectly taught the enlarged tables.

	£	s.	d.
108 cwts. of tobacco at 12*l.* 16*s.* 8*d.* per cwt. ? *Ans.*	1386	0	0.
110 cwts. of currants at 9*l.* 18*s.* 7$\frac{3}{4}$*d.* per cwt.? *Ans.*	1092	11	0$\frac{1}{2}$.
120 chests of tea at 28*l.* 17*s.* 5$\frac{1}{4}$*d.* per chest ? *Ans.*	3464	12	6.
132 gallons of brandy at 1*l.* 17*s.* 11*d.* per gal. ? *Ans.*	250	5	0.
121 ounces of plate at 4*l.* 19*s.* 9*d.* per ounce? *Ans.*	603	9	9.
144 bales of silk at 97*l.* 17*s.* 10$\frac{1}{2}$*d.* per bale ? *Ans.*	14096	14	0.

Should the number be found in the enlarged mutiplication table, proceed in the same manner.

Example. Multiply 19*l.* 10*s.* 7$\frac{1}{4}$*d.* by 304.

£	s.	d.	
19	10	7$\frac{1}{4}$	
		16	
			= 16 times the top line.
		19	
			= 304 times the top line.

16 × 19 = 304

221 tuns of Port wine at	28	17	6	per tun ?	*Ans.*	6381	7	6
240 tuns of Sherry at	27	19	8	per tun ?	*Ans.*	6716	0	0
289 tuns of Madeira at	11	16	9	per tun ?	*Ans.*	3421	0	9
360 tuns of Bucellas at	18	18	0	per tun ?	*Ans.*	6804	0	0
256 tuns of Curaçoa at	20	10	0	per tun ?	*Ans.*	5248	0	0
400 tuns of Claret at	30	10	6	per tun ?	*Ans.*	12210	0	0

Case 3.—When the number is not to be found in the multiplication table, take the two numbers which produce the nearest sum to it, and multiply the top line by that which is over.

Example. Multiply 2*l.* 1*s.* 2$\frac{1}{4}$*d.* by 76.

£	s.	d.	
2	1	2$\frac{1}{4}$ × 4	
		8	
16	9	6	= 8 times the top line.
		9	
148	5	6	= 72 times the top line.
8	4	9	= 4 times the top line.
156	10	3	= 76 times the top line.

8 × 9 = 72 + 4 = 76

yds.		£	s.	d.			£	s.	d.
22	at	1	6	$8\frac{1}{4}$	——	*Ans.*	29	7	$1\frac{1}{2}$
37	at	2	3	4	——	*Ans.*	80	3	4
63	at	1	8	$4\frac{1}{4}$	——	*Ans.*	89	6	$3\frac{3}{4}$
99	at	3	7	5	——	*Ans.*	333	14	3
125	at	5	8	$4\frac{1}{2}$	——	*Ans.*	677	6	$10\frac{1}{2}$
137	at	2	3	$8\frac{3}{4}$	——	*Ans.*	299	10	$10\frac{3}{4}$
114	at	1	5	8	——	*Ans.*	146	6	0
147	at	0	18	$4\frac{1}{2}$	——	*Ans.*	135	1	$1\frac{1}{2}$

By the Enlarged Table.

yds.		£	s.	d.			£	s.	d.
212	at	4	16	0	——	*Ans.*	1017	12	0
218	at	30	19	7	——	*Ans.*	6753	9	2
197	at	74	13	6	——	*Ans.*	14710	19	6
329	at	18	10	9	——	*Ans.*	6098	16	9
345	at	14	17	11	——	*Ans.*	5139	1	3
365	at	16	14	$11\frac{1}{2}$	——	*Ans.*	6112	19	$9\frac{1}{2}$
309	at	17	17	$3\frac{3}{4}$	——	*Ans.*	5520	9	$6\frac{3}{4}$

Case 4.—For any multiplier.

Rule.—If the highest number in the multiplier be tens, multiply by 10, and that product by the number of tens, and the top line by the units, and add the amount together. If the multiplier be hundreds, multiply by 10 twice and that product by the number of hundreds; add to this the top line multiplied by the units in the multiplier, and the second line multiplied by the tens. If the multiplier be thousands, multiply by 10 three times, &c.

Example. Multiply 562*l.* 10*s.* 4*d.* by 125.

562	10	4	× 5
		10	
5625	3	4	× 2
		10	
56251	13	4	= 100 times the top line.
2812	11	8	= 5 times the top line.
11250	6	8	= 20 times the top line.
70314	11	8	= 125 times the top line.

	£	s.	d.					£	s.	d.
Multiply	45	16	$0\frac{3}{4}$	by	84	——	*Ans.*	3847	9	3
	746	19	3	by	43	——	*Ans.*	32119	7	9
	873	11	$1\frac{1}{2}$	by	75	——	*Ans.*	65516	14	$4\frac{1}{2}$
	792	8	$4\frac{1}{4}$	by	85	——	*Ans.*	67355	10	$1\frac{1}{4}$
	345	10	10	by	110	——	*Ans.*	38009	11	8
	473	12	$8\frac{1}{4}$	by	132	——	*Ans.*	62519	14	9
	360	11	11	by	343	——	*Ans.*	123684	7	5
	187	17	$6\frac{1}{2}$	by	256	——	*Ans.*	48096	10	8
	584	11	$3\frac{1}{2}$	by	123	——	*Ans.*	71901	8	$10\frac{1}{2}$
	695	6	10	by	112	——	*Ans.*	77878	5	4
	1287	15	5	by	107	——	*Ans.*	137791	9	7
	6384	4	$4\frac{1}{2}$	by	117	——	*Ans.*	629953	11	$10\frac{1}{2}$
	7462	13	3	by	137	——	*Ans.*	1022384	15	3
	9842	6	$5\frac{1}{2}$	by	149	——	*Ans.*	1466506	2	$3\frac{1}{2}$
	5289	3	$1\frac{1}{4}$	by	582	——	*Ans.*	3078288	6	$7\frac{1}{2}$

Case 5.—Multiplication by Fractional Parts.

RULE.—If the part be $\frac{1}{4}$, take a quarter of the top line.
If —— $\frac{1}{2}$, —— half the top line.
If —— $\frac{3}{4}$, —— half and a quarter of the top line

Example. $8\frac{3}{4}$ yards of lace, 2*s.* $4\frac{1}{2}$*d.* per yard.

	2	$4\frac{1}{2}$
		$8\frac{3}{4}$
	19	0 = 8 times the top line.
	1	$2\frac{1}{4}$ = $\frac{1}{2}$ the top line.
		7 = $\frac{1}{4}$ the top line.
1	0	$9\frac{1}{4}$ = $8\frac{3}{4}$ the top line.

yds.		£	s.	d.			£	s.	d.
$10\frac{1}{4}$	at		1	$4\frac{1}{4}$	——	*Ans.*		13	$10\frac{1}{2}$
$11\frac{3}{4}$	at		15	$9\frac{1}{2}$	——	*Ans.*	9	5	$6\frac{1}{2}$
$25\frac{1}{4}$	at	215	10	4	——	*Ans.*	5441	15	11
$36\frac{1}{2}$	at	84	12	3	——	*Ans.*	3088	7	$1\frac{1}{2}$
$72\frac{3}{4}$	at	127	4	11	——	*Ans.*	9257	2	$8\frac{1}{4}$
$99\frac{1}{2}$	at	41	3	$6\frac{1}{2}$	——	*Ans.*	4097	2	$4\frac{3}{4}$
$132\frac{3}{4}$	at	52	17	4	——	*Ans.*	7018	1	0
$210\frac{1}{4}$	at	521	3	4	——	*Ans.*	109575	5	10
$414\frac{1}{2}$	at	124	1	$2\frac{3}{4}$	——	*Ans.*	51423	9	$5\frac{3}{4}$
$1000\frac{3}{4}$	at	1000	1	$0\frac{1}{4}$	——	*Ans.*	1000801	1	7

Questions in Multiplication of Money.

1. What sum will pay for 12 hats at 15*s.* 10*d.* each? *Ans.* 9*l.* 10*s.*

2. An upholsterer sold 16 tables at 50*s.* each, 12 chests of drawers at 3*l.* 13*s.* 6*d.* each, 9 dozen chairs at 4 guineas a dozen, 8 mirrors at 3½ guineas each, 4 sofas at 9*l.* 10*s.* 6*d.* each, 6 pier-glasses at 7 guineas and half-a-crown each, and 3 book-cases at 15 pounds, 15 shillings, and 15 pence each, what was the amount of his bill? *Ans.* 281*l.* 13*s.* 9*d.*

3. What sum is required to pay 56 men for 10 weeks' work at 1*l.* 3*s.* 6*d.* each man per week? 658*l.*

4. A gentleman spends on an average daily 1*l.* 3*s.* 4*d.* and lays by 50*l.* quarterly, what is his income? *Ans.* 625*l.* 16*s.* 8*d.*

5. The average of the weekly returns of promissory notes and post bills during a part of the year 1831 was 19,693,978*l.* 15*s.* 6½*d.*, what would be the amount for 52 weeks?

Ans. 1,024,086,896*l.* 8*s.* 2*d.*

6. The produce of the stamp duty in 1831 was 6,578,181*l.*, what would it amount to in 99 years at that average?

Ans. 651,239,919*l.*

7. How many pounds sterling in 29 purses, each purse having 12 guineas, 13 seven-shilling pieces, 5 crowns, and 5 sixpences?

Ans. 537*l.* 4*s.* 6*d.*

8. If a bankrupt pay 13*s.* 7*d.* in the pound, what sum will he pay to a debt of 4572*l.* *Ans.* 3105*l.* 3*s.*

9. What is the value of 1476½ ounces of gold, at 3*l.* 15*s.* 4¼*d.* per ounce? *Ans.* 5564*l.* 11*s.* 2¼*d.*

10. A merchant began trade with 20,000*l.* The first 3 years he gained yearly on an average 919*l.* 5*s.* 6½*d.*; the next year he lost 1419*l.* 17*s.* 7*d.*, but the 4½ following years he gained at the rate of 763*l.* 5*s.* 2½*d.* a year; what did he then die possessed of?

Ans. 24,772*l.* 12*s.* 5¾*d.*

11. A dozen gross of knives at 7*s.* 6*d.* per dozen? *Ans.* 54*l.*

12. What will 50 loads of corn cost at 18*l.* 12*s.* per load?

Ans. 930*l.*

13. 793 Spaniards obtained from the Peruvians on an average 6742*l.* 12*s.* 10½*d.* each; what was the whole amount of the sums of which they gained possession? *Ans.* 5,346,916*l.* 9*s.* 10½*d.*

14. What sum is left of a fifty pound note, after paying for the following articles:—25 yards of sheeting at 2*s.* 1½*d.* per yard; 17½ yards of dowlas at 11¾*d.* a yard; 7 table-cloths at 1*l.* 1*s.* 3½*d* each; 33¾*d.* yards of ticking at 13¾*d.*; and 11 dozen of tape at 5 yards for three farthings? *Ans.* 37*l.* 0*s.* 5*d.*

DIVISION OF MONEY

TEACHES TO DIVIDE A SUM OF MONEY INTO EQUAL PARTS.

Case 1.—When the divisor does not exceed 12.

RULE.—Divide the pounds as in simple division, and carry 20 to the shillings for every pound over. Add this number of shillings to the shillings contained in the dividend. Divide this whole amount of shillings and set down the quotient under the shillings. If any shillings are over, carry their value in pence to the pence. Divide the whole number of pence, set down the quotient under the pence, and carry 4 to the farthings. Divide the number of farthings and set down as before.

Example. Divide 3*l.* 2*s.* 9¼*d.* by 2.

£	s.	d.
2)3	2	9¼
1	11	4½

2 in 3 will go once and 1 over, set down 1 under the 3 and carry 20; 20 and 2 are 22; 2 in 22 gives 11 times for the shillings; 2 in 9 four times and 1 over, set down 4 and carry 4 farthings to the farthings; 4 and 1 are 5, 2 in 5 twice, set down ½ and 1 over.

Exercises.

£	s.	d.		£	s.	d.	
Divide 302	8	4½	by 2	Divide 18890	8	11½	by 10
1316	3	8	— 4	22832	15	6¾	— 11
3069	18	9	— 6	77200	10	9	— 12
2724	15	7¼	— 3	97617	17	4¾	— 5
1081	16	9¼	— 5	97943	1	8½	— 7
7219	19	10½	— 6	578370	5	0¼	— 9
6048	11	0	— 7	656081	19	2½	— 8
2261	2	2	— 8	39200	11	5¼	— 11
18383	7	0¾	— 9	92665	16	9	— 12

BY THE ENLARGED TABLE.

Divide 20,415*l.* 18*s.* 6½*d.* by 13, 14, 15, 16, 17, 18, 19, 20

Case 2.—When the divisor exceeds 20.

RULE.—Divide the pounds as in simple long division, Multiply the remainder by 20, add the shillings of the dividend, and divide as before. Multiply the remainder by 12, add the pence and divide again. Multiply the remainder by 4, add the farthings of the dividend, and proceed as before.

Example. Divide 3252*l.* 16*s.* 2½*d.* by 456.

£ s. d.
456)3252 16 2½(7*l.*
3192
60*l.*
20
456)1216(2*s.*
912
304*s.*
12
456)3650(8*d.*
3648
2*d.*
4
10

After dividing the pounds the remainder is 60, which multiplied by 20, with 16 added, makes 1216; which divided gives 2, and 304 remainder. This brought into pence, and the 2 pence added, gives 3650; which again divided gives 8*d.* and 2*d.* remainder. This multiplied by 4, with the half-penny added, gives 10 as a final remainder. The answer is, therefore, 7*l.* 2*s.* 8*d.*—$\frac{10}{456}$.

Exercises.

	£	s.	d.			£	s.	d.
Divide	425	10	8¼ by	30	*Ans.*	14	3	8¼
	384	11	7 by	38	*Ans.*	10	2	4¾
	547	12	2¼ by	25	*Ans.*	21	18	1
	394	17	3¾ by	53	*Ans.*	7	9	0
	928	11	4¼ by	69	*Ans.*	13	9	1¾
	388	12	2 by	107	*Ans.*	3	12	7½
	444	14	4 by	214	*Ans.*	2	1	6½
	379	12	2½ by	365	*Ans.*	1	0	9½

Case 3.—When the divisor contains a quarter, half, or three quarters.

Rule.—Multiply both the dividend and the divisor by 4, and divide as in *Case* 2.

Example. Divide 142*l.* 10*s.* 6*d.* by 12¾*d.*

142*l.* 10*s.* 6*d.*×4=570*l.* 2*s.* 0*d.*; 12¾*d.*×4=51, therefore the question will stand

£ s. d.
51) 570 2 0 (

Divide	125	8	10½ by	5½	——	*Ans.*	22	16	1¾
	37	3	6 by	17¼	——	*Ans.*	2	3	1
	361	8	10¼ by	45⅔	——	*Ans.*	7	18	0
	1842	10	4 by	120½	——	*Ans.*	15	6	5½

Questions in Division of Money.

1. What is the 12th part of 11*l.* 11*s.* 11¼*d.*? *Ans.* 19*s.* 3¾*d.*
2. 150*l.* per annum is how much per week?
Ans. 2*l.* 17*s.* 8¼*d.*—12 remainder.
3. How many persons may dine for 100*l.* at 3*s.* each? *Ans.* 666.
4. Twelve bars of gold, valued at 185*l.* each, were found by 5 men; what was each man's share? *Ans.* 444*l.*
5. What is the 145th part of one million of sovereigns?
Ans. 6896*l.* 11*s.* 0½*d.*—95 remainder.
6. A tradesman gained 15,200*l.* in 16 years, what was the average gain per year? *Ans.* 950*l.*
7. In a regiment consisting of 1000 men there were 50 officers, how many private men to an officer? *Ans.* 19.
8. If a purse and money are worth 20*l.* and the money is worth nine times the purse, what is the value of each?
Ans. money 18*l.*, purse 2*l.*
9. If 50 reams of paper cost 25*l.* what is that per sheet, 480 sheets to the ream? *Ans.* ¼*d.*
10. What sum added to the 20th part of 2590*l.* will make it 500*l.*? *Ans.* 370*l.* 10*s.*
11. If the yearly income be 300*l.*, what is that per month, week, and day? *Ansrs.* 25*l.*—5*l.* 15*s.* 4½*d.*—16*s.* 5¼*d.*
12. 860 gross of scissors cost 387*l.*, what is that per pair?
Ans. ¾*d.*
13. A work in 8vo., making 15 sheets, cost 5 shillings, what was that per page? *Ans.* ¼*d.*
14. 14½ yards of velvet for 19*l.* 8*s.* 8*d.*, what was the cost per yard? *Ans.* 1*l.* 6*s.* 9½*d.*
15. If a merchant gained 12,205*l.* in 6¼ years, what was his yearly profit? *Ans.* 1952*l.* 16*s.*
16. 12 men and a boy have earned 45*l.* 17*s.* 10½*d.*, the boy is to receive 9 half-crowns, what is each man's share?
Ans. 3*l.* 14*s.* 7¼*d.*
17. 1200*l.* per annum, what is that per month, week, and day?
Ansrs. 100*l.*—23*l.* 1*s.* 6¼*d.*—3*l.* 5*s.* 9*d.*
18. 555¾ for 2877*l.* 12*s.* 8*d.*, what is that for each?
Ans. 5*l.* 3*s.* 6½*d.*
19. One hundred and fifty pounds were paid for 100,000 bricks, what was that per dozen bricks? *Ans.* 4¼*d.*
20. Divide 10,416*l.* 13*s.* 4*d.* among one million persons, what will each receive? *Ans.* 2½*d.*
21. If 112 ingots of gold are worth 77,878*l.* 5*s.* 4*d.*, what is the value of one? *Ans.* 695*l.* 6*s.* 10*d.*

TABLES OF WEIGHTS AND MEASURES.

MONEY.

Farthings.

2 = 1 halfpenny.
4 = 2 = 1 penny.
48 = 24 = 12 = 1 shilling.
960 = 480 = 240 = 20 = 1 pound.

TROY WEIGHT.

Grains, grs.

24 = 1 pennyweight, dwts.
480 = 20 = 1 ounce, oz.
5760 = 240 = 12 = 1 pound, lb.

Gold, silver, jewels, and most liquids are weighed by this weight.

AVOIRDUPOISE WEIGHT.

Drams.

16 = 1 ounce.
256 = 16 = 1 pound.
7168 = 448 = 28 = 1 quarter.
28672 = 1792 = 112 = 4 = 1 hundred weight.
573440 = 35840 = 2240 = 80 = 20 = 1 ton.

Bread, meat, grocery, and goods in general, and all metals except gold and silver, are weighed by this weight.

APOTHECARIES' WEIGHT.

Grains, grs.

20 = 1 scruple, ℈
60 = 3 = 1 dram, ʒ
480 = 24 = 8 = 1 ounce, ℥
5760 = 288 = 96 = 12 = 1 pound, lb.

The pound and ounce are equal to those of Troy Weight.

CLOTH MEASURE.

Inches.

$2\frac{1}{4}$ = 1 nail.
9 = 4 = 1 quarter.
36 = 16 = 4 = 1 yard.
27 = 12 = 3 = 1 *Flemish ell.*
45 = 20 = 5 = 1 *English ell.*
54 = 24 = 6 = 1 *French ell.*

N.B. Those in Italics are obsolete.

LONG MEASURE.

Barleycorns.
3 = 1 inch.
12 = 1 foot.
36 = 3 = 1 yard.
198 = 16½ = 5½ = 1 pole, rod, or perch.
7920 = 660 = 220 = 40 = 1 furlong.
63360 = 5280 = 1760 = 320 = 8 = 1 mile.
3 = 1 league.

LAND OR SQUARE MEASURE.

Inches.
144 = 1 foot.
1296 = 9 = 1 yard.
39204 = 272¼ = 30¼ = 1 pole.
1568160 = 10890 = 1210 = 40 = 1 rood.
6272640 = 43560 = 4840 = 160 = 4 = 1 acre.
640 square acres make 1 square mile.

The square of a number is obtained by multiplying the number by itself, as 12 × 12 = 144, the square of 12.

CUBIC OR SOLID MEASURE.

1728 solid inches ..... make 1 cubic foot.
27 solid feet ..... make 1 cubic yard.
42 cubic feet ..... make 1 ton of shipping.

The cube of a number is obtained by multiplying a number twice by itself, as 12 × 12 × 12 = 1728, the cube of 12.

WINE MEASURE.

Pints.
2 = 1 quart.
8 = 4 = 1 gallon.
336 = 168 = 42 = 1 *tierce*.
504 = 252 = 63 = 1½ = 1 *hogshead*.
672 = 336 = 84 = 2 = 1⅓ = 1 *puncheon*.
1008 = 504 = 126 = 3 = 2 = 1½ = 1 *pipe*.
2016 = 1008 = 252 = 6 = 4 = 3 = 2 = 1 *tun*.

ALE AND BEER MEASURE.

Pints.
2 = 1 quart.
8 = 4 = 1 gallon.
72 = 36 = 9 = 1 *firkin*.
144 = 72 = 18 = 2 = 1 *kilderkin*.
288 = 144 = 36 = 4 = 2 = 1 *barrel*.
432 = 216 = 54 = 6 = 3 = 1½ = 1 *hogshead*.
864 = 432 = 108 = 12 = 6 = 3 = 2 = 1 *butt*

DRY MEASURE.

Gallons.							
2	=	1 peck.					
8	=	4	=	1 bushel.			
16	=	8	=	2	=	1 *strike.*	
32	=	16	=	4	=	2	= 1 *coomb.*
64	=	32	=	8	=	4	= 2 = 1 quarter.
320	=	160	=	40	=	20	= 10 = 5 = 1 *wey* or *load.*
640	=	320	=	80	=	40	= 20 = 10 = 2 = 1 *last.*

HAY AND STRAW.

56 lbs. of old hay
60 lbs. of new hay } 1 truss.
36 lbs. of straw

36 trusses.....1 load.

TIME.

Seconds.										
60	=	1 minute.								
3600	=	60	=	1 hour.						
86400	=	1440	=	24	=	1 day.				
604800	=	10080	=	168	=	7	= 1 week.			
2419200	=	40320	=	672	=	28	= 4	= 1 month.		

SEC.		M.		H.		D.	H.	W.	D.	H.	
31557600	=	525960	=	8766	=	365	6	= 52	1	6	= 1 Julian year.

					D.	H.	M.		
31556937	=	525948	=	8765	=	365	5	48	57″ = 1 Solar year.

To know how many days are in each month, observe:

Thirty days hath September,
April, June, and November;
February hath twenty-eight alone,
And all the rest have thirty-one;
Excepting leap-year, at which time
February's days are twenty-nine.

Every fourth year is called leap year, and consists of 366 days.

THE QUARTER DAYS.

Lady Day..... March 25th.
Midsummer Day..... June 24th.
Michaelmas Day ..... September 29th.
Christmas Day..... ..... December 25th.

ASTRONOMICAL TABLE.

60 seconds (″) make 1 minute.
60 minutes (′) make 1 degree.
30 degrees (°) make 1 sign.
12 signs, or 360°, complete the zodiac.

MONEY MENTIONED IN SCRIPTURE.

		£	s.	d.
A Gerah	=	0	0	1
A Zuzah	=	0	0	6
A Bekah	=	0	1	1
A Shekel (Silver)	=	0	2	3
Golden Daric or Dram	=	1	1	10
A Shekel of Gold	=	1	16	5
A Maneh or Mina	=	5	13	10
A Talent of Silver	=	341	10	4
A Talent of Gold	=	5464	5	8
Piece of Silver (Drachm)	=	0	0	$7\frac{3}{4}$
Tribute Money (Didrachm) 2 drams	=	0	1	$3\frac{1}{2}$
Piece of Silver (Stater) 4 drams	=	0	2	7
Pound (Mina) 100 drams	=	3	4	7
Penny (Denarius)	=	0	0	$7\frac{1}{2}$
Farthing (Assarium)	=	0	0	$0\frac{3}{8}$
Farthing (Quadrans)	=	0	0	$0\frac{3}{16}$
A Mite	=	0	0	$0\frac{3}{32}$

MISCELLANIES.

20	1 score	Sack of wheat	5 bush.
144	1 gross	Sack of flour	3 bush.
24 sheets of paper	1 quire	Quartern loaf weighs	4 lbs. 5oz.
20 quires	1 ream	Stone	14 lbs.
Folio	2 leaves to the sheet	Ton of Coal	10 sacks
Quarto	4 ditto	Ton of Potatoes	40 bush.
8vo.	8 ditto	Quintal	100 lbs.
Hand	4 inches	Square of flooring	100 feet
Fathom	6 feet	Hide of land	100 acres
Cubit, 18in.	Sacred 22in. nearly	Calendar months in a year	12
Noble	6s. 8d.	Lunar ditto	13
Angel	10 0	A French franc	10d.
Mark	13 4	A do. sou	$\frac{1}{2}d.$
1 lb. of Gold makes	$46\frac{2}{10}$ sovs.	100 Centimes	1 franc
1 lb. of Silver do.	66 shillings	A Napoleon	20 „
1 lb. of Copper do.	24 pence	A Sovereign is worth	25 „

WEIGHTS AND MEASURES.

Arrange the numbers as in the money rules, and borrow and carry according to the kind of weight or measure under consideration.

In Addition, after having added up a column, divide the amount by as many as make one of the next kind or denomination; write the remainder under the column added, and carry the number to the next column.

In Subtraction borrow as many as make one of the next kind and afterwards carry or pay back the one to its own column.

In Multiplication proceed as in Addition with regard to carrying.

In Division, for every one over carry as many as that one contains of the next kind.

TROY WEIGHT.

Addition.

lbs.	ozs.	dwts.
19	1	15
7	11	19
12	10	8
4	7	13

ozs.	dwts.	grs.
10	19	23
11	16	20
8	14	16
7	18	15

Subtraction.

lbs.	ozs.	dwts.
16	10	19
14	11	15

ozs.	dwts.	grs.
14	6	10
13	11	23

Multiplication.

lbs.	ozs.	dwts.
41	3	19
		9

ozs.	dwts.	grs.
63	11	18
		11

Division.

lbs.	ozs.	dwts.
7) 22	5	6

ozs.	dwts.	grs.
9) 10	16	17

1. A Jew bought a quantity of old plate, of which was made a cream-pot weighing 3 ozs. 2 dwts., a teapot 18 ozs. 16 dwts. 19 grs., 12 silver forks 22½ ozs., a salver 1 lb. 2¼ ozs.; what weight of silver was the whole when melted?

Ans. 4 lbs. 10 ozs. 13 dwts. 19 grs.

2. A British ship captured a Spanish galleon, which had on board 7658 ounces of silver in ingots, 2785 in dollars, 56 ozs. 17 dwts. 19 grs. in plate, 256 ounces of gold in wedges, and 471 ozs. 17 grs. in coin; what was the whole amount in ounces?

Ans. 11,226 ozs. 18 dwts. 12 grs.

3. A gentleman had a service of plate which weighed a thousand ounces. Some thieves broke in and stole 2 pairs of silver candlesticks weighing 9 ozs. 10 dwts. 5 grs. each pair; a silver ewer weighing 36,920 grains; 3 dozen spoons, each spoon weighing 18 dwts.; and 6 dozen tea-spoons weighing 25 ozs. per dozen. What did his loss amount to, and how many ounces of plate had he left?

Ans. 278 ozs. 6 dwts. 18 grs. loss; 721 ozs. 13 dwts. 6 grs. left.

4. What is the weight of $6\frac{3}{4}$ dozen of tea-spoons, each of which weighs half an ounce? *Ans.* 40 ozs. 10 dwts.

5. A silversmith sold 18 ingots of silver, each weighing 3 lbs. 9 ozs. 17 dwts.; 74 dollars weighing 19 dwts. 23 grs. each; 99 ancient shillings, each weighing 10 dwts. 2 grs.; 10 dozen silver buckles, weighing each pair 16 dwts. 18 grs. What weight of silver did he sell altogether? *Ans.* 83 lbs. 3 ozs. 6 dwts. 4 grs.

AVOIRDUPOISE WEIGHT.

1. The great bell of St. Paul's weighs 5 tons 2 cwt. 1 qr. 22 lbs.; how much heavier is the great bell at Oxford, which weighs 7 tons, 11 cwts. 3 qrs. 4 lbs.; and what is their united weight?

Ans. 2 tons 9 cwts. 1 qr. 10 lbs. difference; 12 tons 14 cwts. 26 lbs. weight together.

2. Two porters had to carry 2 hogsheads of tobacco, the first weighed 2 cwts. 14 lbs., the second 4 cwts. 3 qrs. 27 lbs. 15 ozs. 14 drs.; which porter carried the greater weight, and what was the difference?

Ans. The second porter carried the greater; and the difference is 2 cwts. 3 qrs. 13 lbs. 15 ozs. 14 drs.

3. What is the weight of 7 bags of hops weighing 12 cwts. 16 lbs. each? *Ans.* 85 cwts.

4. What is the weight of 18 sacks of potatoes weighing 180 lbs. each? *Ans.* 28 cwts. 3 qrs. 20 lbs.

5. What is the weight of 24 barrels of tar weighing 1 cwt. 2 qrs. 17 lbs. 5 ozs. each? *Ans.* 39 cwts. 2 qrs. 23 lbs. 8 ozs.

6. What is the weight of 144 hogsheads of tallow weighing 13 cwt. 10 lbs. each? *Ans.* 94 tons 4 cwts. 3 qrs. 12 lbs.

7. Twenty large puddings, weighing 10 lbs. 7 ozs. each, were to be divided among 144 poor children; what was the share of each? *Ans.* 1 lb. 7 ozs. 3 drs.

8. A family of 11 had 14 stone 13 ozs. of meat, how much might each eat per day for this to last them a week? *Ans.* 1 lb. 7 ozs. 7 drs.

9. A ship's company of 132 men had 7 tons 18 cwts. of biscuit, which was to last 3 weeks, what was each man's share per day?

Ans. 6 lbs. 6 ozs. 2 drs.

APOTHECARIES' WEIGHT.

1. A prescription contained the following articles: sulphate mag. ℥j. 3iv., carb. potass. 3vj., water ℥j. 3iij.; what was its weight? *Ans.* ℥iij. 3v.

2. 12 powders contained 3iij. ℈ij. grs. viij. of potass., what quantity was in each? *Ans.* grs. xix.

3. A druggist ordered lb. xxx., of Epsom salts, 3iij. calomel, lb. j. grs. xvj. of antimony, 3vij. grs. xiv. arsenic, lb. xvj. ℥v. carb. soda, lb. xiij. of Tartaric acid, lb. x. of magnesia, lb. xvj. of potass. The packages of these articles weighed lb. j. ℥vij. 3ij. grs. xix., what weight had the porter to carry?

Ans. lb. lxxxviij. ℥j. 3iv. ℈ij. grs. ix.

4. A child took the following draught: tinct. senna ℈ij. sal. magnesia grs. xvij., tart. potass. ℈j. grs. xiv., water ℥j½; an adult took 3ij. of the first, ℈ij. of the second, and ℥j. of the third; what did the adult's dose exceed the child's? *Ans.* 3v. grs. ix.

5. There were mixed together ℥j. of rhubarb, ℈ij. of antimony, 3iv. ℈j. grs. xij. of jalap, cxliv. grs. of calomel; if 144 pills were made of this, what was the weight of each pill? and how much rhubarb, and how much calomel, did each contain?

Ans. grs. vj½. weight of each pill.—grs. iij⅓. of rhubarb—and gr. j. of calomel.

LONG MEASURE.

1. Which measures most, and by how much, a road 117 miles, 6 furlongs, 20 poles long; or 2 measuring 49 miles, 3 furlongs, 29 poles, 4 yards, 2 feet each?

Ans. The first measures most by 18 m. 7 fur. 1 yd. 2 ft.

2. A joint-stock company of 14 persons had a turnpike road 18 miles long in their hands, what quantity of it belonged to each individual? *Ans.* 1 m. 2 fur. 11 p. 2 yds. 1 ft. 2 b.c.

3. A man had to travel a certain distance, and he first walked 100¾ m., then rode 216 m. 5 fur. 8 p., then walked 117 m. 19 p., then rode again 200 m.; what was the extent of his journey? He accomplished the whole in 5 days, how much was that per day?

Ans. 634 m. 3 fur. 27 p., and 126 m. 7 fur. 5 p. 2 yds. 7 in. per day,—1 remainder.

4. A surveyor had to keep in repair 5 roads; the first contained 2 m. 17 p., the second 5 m. 6 fur., the third 16 m., the fourth 2 fur. 10 p., the fifth half the length of all the others; what length of road had he in charge? *Ans.* 36 m. 1 fur. 2 yds. 2 ft. 3 in.

LAND MEASURE.

1. A farm consisted of 5 fields, one measured 24 a. 2 r. 19 p., another 19 a. 3 r. 25 p., the third 11 a. 1 r. 5 p., the fourth 17 a. 12 p., the fifth 25 a.; what was the amount of the five fields?

Ans. 97 a. 3 r. 21 p.

2. A farmer sowed a field with wheat 14½ a., one with barley 12¼ a., one with oats 14 a. 17 p., one with beans 25¾ a.; he had in meadow 144 a. 2 r. 14 p., and 2 fields fallow of 13 a. 3 p. each; what quantity of land did his farm contain? and how much less cultivated than uncultivated land?

Ans. the farm contained 237 a. 37 p., and 104 a. 0 r. 3 p. less.

3. A hay field, containing 115 a. 17 p., was mown by 6 men, how much did each man mow? *Ans.* 19 a. 29 p.+

4. The parish field of a certain town contained 56 a. 1 r. 25 p., 150 paupers were put on it, and dug the whole over in one day; what quantity of land did each man dig up?

Ans. 1 r. 20 p. 5 yds. 0 ft. 54 in.

5. A gentleman purchased a piece of ground which measured 1171 a. 2 r. 26 p.; of this he took 258 a. for a park, 1 a. 2 r. 19 p. for a house, 3 r. 12 p. for kitchen garden, and 4 a. 7 p. for a shrubbery; what quantity had he left to let for cultivation?

Ans. 907 a. 28 p.

DRY MEASURE.

1. A miller having bought a lot of corn, sent his waggons to fetch it; the first brought 25 qrs. 4 bush., the second 19 qrs. 2 pecks, the third 23½ qrs., the fourth 17 qrs. 7 bush. 3 pecks; what quantity of corn did he purchase? *Ans.* 86 qrs. 1 peck.

2. A baker used 3 sacks 1 bushel of flour on Monday, 5 sacks 2 pecks on the Wednesday, 8 sacks 2 bush. 3 pecks on the Friday, and 10 sacks on the Saturday; half the first was best flour, a third of the second, a fourth of the third, and a fifth of the fourth; which did he use most of, the best or seconds flour; and how much of each?

Ans. Seconds.—7 sacks, 1 bush. 2 pecks, best.—19 sacks, 2 bush. 3 pecks, seconds.

3. A granary contained 5 stories, each story 4 rooms; the first floor first room contained 286 qrs. 3 bush. 2 pecks of corn, the second 391 qrs. 2 bush. 3 pecks, the third 261 qrs. 1 peck, the fourth 89 qrs. 1 bush.; each of the other stories contained 1562 qrs. What was the whole amount? *Ans.* 7275 qrs. 7 bush. 2 pecks.

4. A mealman bought 15 parcels of wheat, each containing 25 qrs. 7 bush. 3 pecks; what quantity did he buy?

Ans. 389 qrs. 4 bush. 1 peck.

5. There were 175 weys of wheat sold amongst 96 buyers, what was the share of each?

Ans. 1 wey, 4 qrs. 3 pecks, 1 gal. 1 qt., 64 rem.

6. How many sacks, holding 3½ bushels, will it require to clear a barn having 125 bushels in it? *Ans.* 35. +

7. If a ship's crew of 260 men consume 299 qrs. 3 bush. of wheat in a month, how much is that for each man?

Ans. 1 qr. 1 bush. 1 gal. 2 qts. 1 pt. +

8. A waggon having 6 horses contained the following quantities of grain: 6 qrs. of oats, 3 bush. of hemp seed, 15 qrs. 2 bush. 3 pecks of wheat, 6 qrs. 2 pecks of rye, 18 qrs. of barley, and 12 bush. of beans; what quantity was the draught of each horse? *Ans.* 7 qrs. 7 bush. 1 qt. +

9. Sixteen horses ate 14 qrs. 3 bush. and a peck of corn in a month of 28 days; what was that per day each? *Ans.* 1 peck. +

WINE, ALE, AND BEER MEASURES.

1. A gentleman's stock of wines was 4½ pipes of port, 2 puncheons of sherry, 3 pipes of claret; of Madeira, 72 gals., of mountain, 1 hhd. 44 gals. 1 pint; what quantity of liquor did his cellar contain? *Ans.* 5 tuns, 32 gals. 1 pint.

2. A wine merchant had 15 pipes of sherry, half as much port, two-thirds as much Madeira. Now he had 64 gals. of rum in his cellar, and twice as much gin, with half as much brandy; what quantity of each had he? and how much did the wine exceed the spirits in his cellar?

Ans. He had 16 tuns, 1 hhd. of wine, and 1 pipe, 1 hhd. 35 gals. of spirits; and the wine exceeded the spirits 15 tuns, 1 hhd. 28 gals.

3. A cider-maker sent to London 4 tuns, 1 hhd. of cider, which was sold among 12 merchants; these sold it again amongst 10 retailers; what was the share of each merchant, and the share of each retailer?

Ansrs. To each merchant, 1 hhd. 26 gals. 1 qt.—To each retailer, 8 gals. 3 qts. 1 pt. 1 gill, 6 rem.

4. A pipe of canary wine sprung a leak, and a pail and tub, standing under it, the former caught 5 gals. and the latter 37; the rest running over, only about 14 pints could be saved; I desire to know what was lost, and how much was saved?

Ans. 350 pts. saved.—658 pts. lost.

5. A hhd. of ale was set out at a nobleman's feast to his tenantry, of whom 120 were present: a firkin and a kilderkin being drawn off for the household, what did each person consume? *Ans.* 1+pt. or $1\frac{4}{5}$ pt.

6. At a great fire which took place at a wine-merchant's, there were 2 pipes of port, $1\frac{1}{2}$ tun of Madeira, and 1 puncheon of rum in the cellar; from the first 3 beer barrels were filled; from the second 13 dozen of quart bottles were also filled; from the third they managed to obtain a $4\frac{1}{2}$ gallon canful, 3 pints of which were spilled in taking it up the stairs; what quantity in gallons was in the cellar, and how much was saved?

Ansrs. There were in the cellar 714 gals.; and 151 gals. 1 pint saved.

MISCELLANEOUS EXERCISES.

1. How many suits of clothes which take 4 yards each can be made out of a piece of cloth measuring 117 yards? *Ans.* 29. +

2. If a pair of trowsers take $2\frac{1}{4}$ yards, a waistcoat $\frac{3}{4}$ of a yard, a coat $1\frac{3}{4}$ of a yard of cloth, what quantity would it take for 84 pairs of trowsers, 63 coats, and 120 waistcoats? *Ans.* $389\frac{1}{4}$ yds.

3. If a piece of tape measures $26\frac{3}{4}$ yards and 1 nail, what will 210 measure? *Ans.* 5630 yds. 2 qrs. 2 nls.

4. What is the difference between a roll of silk that measures 154 yards, and 3 rolls measuring $17\frac{3}{4}$ each? And what do all measure together?

Ans. The difference $100\frac{3}{4}$ yds.; and they measure together $207\frac{1}{4}$ yards.

5. There were 7 sticks of hewn timber; the 3 first contained 2 tons, 19 feet, 659 inches; the other four $1\frac{1}{2}$ tons. Which of the two lots contained the most timber, and what was the difference?

Ans. 44 ft. 659 in.

6. The above timber being bought by 5 persons, how much had each to pay for? *Ans.* 38 ft. $1514\frac{1}{5}$ in.

7. A ship was 7 weeks, 3 days, 7 hours, 15 seconds sailing to the Azores; thence to Nova Zembla, 9 months, 17 days; thence to the coast of China, 4 months; thence to London, 5 months, 2 weeks, 4 days. How long was she sailing round the world; and did she complete her voyage in a longer or shorter time than Commodore Anson, who sailed round it in three years?

Ans. The difference is 1 yr. 2 m. 3 w. 3 d. 16 h. 59 m. 45 s.

Note.—The authors suggest that about this period of the pupil's study, he should frequently copy and work the "Bills of Parcels," of "Book Debts," and "Receipts," at the end of this Work.

REDUCTION

TEACHES TO BRING NUMBERS FROM ONE NAME OR DENOMINATION TO ANOTHER NAME, WITHOUT ALTERING THEIR VALUE.

RULE.—To bring any number to a *lower* name, *multiply* by as many of the less as make one of the greater: to bring it to a *higher* name, *divide*.

Example 1.—From a higher to a lower name.

£ s. d.
Bring 24 8 6¼ to farthings.
20 shillings make 1*l*.

488 shillings in 24*l*. 8*s*.
12 because 12*d*. 1 shilling.

5862 pence in 24*l*. 8*s*. 6*d*.
4 because 4 farthings 1*d*.

23449 farthings in 24*l*. 8*s*. 6¼*d*.

Example 2.—From a lower to a higher name.

Bring 23449 farthings into pence, shillings, and pounds.

4) 23449

12) 5862¼*d*. in 23449 farthings.

20) 488*s*. 6*d*. in 5862 pence.

24*l*. 8*s*. 6¼*d*. in 488½ shillings.

1. In 15*l*. 8*s*. 7½*d*. how many farthings? *Ans.* 14814.
2. Reduce 75*l*. 17*s*. 10*d*. to pence. *Ans.* 18214.
3. Reduce 350*l*. 16*s*. 8¼*d*. to farthings. *Ans.* 336801.
4. In 27 guineas, how many pence? *Ans.* 6804.
5. In 100 crowns, how many farthings? *Ans.* 24000.
6. In 4873*l*. 17*s*. 11½*d*. how many halfpence? *Ans.* 2339471.
7. In 5084 pence, how many farthings? *Ans.* 20336.
8. In 21368 farthings, how many pounds? *Ans.* 22*l*. 5*s*. 2*d*
9. In 10,000 pence, how many guineas? *Ans.* 39. +

10. In 1000 shillings, how many guineas? *Ans.* 47. +
11. In 1200 groats, how many crowns? *Ans.* 80.
12. Reduce 3807 pieces of 27 shillings each to sixpences. *Ans.* 205,578.
13. In 1000*l.* how many groats? *Ans.* 60,000.
14. In 45,768 pence, how many crowns at 64 pence each? *Ans.* 715. +
15. In 52,482 twopences, how many sixpences, half-crowns, and crowns? *Ans.* 17,494.—3498. +—1749.
16. In 1000 crowns, as many half-crowns, shillings, sixpences, and pence, how many farthings? *Ans.* 436,000.
17. How many piastres, at 3*s.* 4*d.* each, are there in 1875*l.* 13*s.* 4*d.*? *Ans.* 11,254.
18. In 360 pence, as many farthings and guineas, how many crowns and pounds, and of each an equal number? *Ans.* 303. +
19. A labourer dug up an equal number of ancient gold, silver, and copper coins; each gold coin was worth 22*s.* 6*d.*, each silver one 3*s.* 9*d.*, and each copper one 1*d.*; the value of the whole was 65*l.* 16*s.* 8*d.*, how many were there of each sort? *Ans.* 50.
20. In a public school half the boys wrote in copy books, and paid 3*d.* each per week, 99 paid 2*d.* each per week, and 59 paid 1*d.*; how many did the school contain, and what was the weekly receipt? *Ans.* 316.—3*l.* 11*d.*
21. A gentleman, meeting a number of poor people, divided among them the contents of his purse; to every man he gave half a crown, to every woman half as much, and to every child 3*d.*; the number of each was equal, and the whole bounty amounted to 5*l.* 8*s.*; how many did he relieve? *Ans.* 81.

TROY WEIGHT.

1. In 17 lbs. of gold how many grains? *Ans.* 97,920.
2. In 97,920 grs. how many pounds? *Ans.* 17.
3. In a silver tea-pot, weighing 15½ ozs., how many grains? *Ans.* 7440.
4. How many table-spoons, each weighing 8 ozs. 5 dwts. can be made out of 19 ozs. 3 dwts. 14 grs.? *Ans.* 5. +
5. In 18 ingots of silver, each weighing 6 lbs. 10 ozs. 17 dwts., and 6 ingots, each weighing 7 lbs. 2 ozs. 18 grs., how many dwts.? *Ans.* 40,150. +
6. Required the quantity of gold to make 7 watch cases, each weighing 1 oz. 18 grs., and 9 others of 1 oz. 10 dwts. each? *Ans* 1 lb. 8 ozs. 15 dwts. 6 grs

AVOIRDUPOISE WEIGHT.

1. In 9 cwts. 3 qrs. 14 lbs. 8 ozs., how many drams?
Ans. 283,264

2. In 225,920 drams, how many cwts.?
Ans. 7 cwts. 3 qrs. 14 lbs. 8 ozs

3. How many tons in 4,720,681 ozs.?
Ans. 131 tons 14 cwts. 1 qr. 6 lbs. 9 ozs.

4. How many parcels, each weighing 2 lbs. 10 ozs. 13 drs., are there in 14 cwts.? *Ans.* 585. +

5. In 9 great pounds of silk, each 24 ozs., how many drams?
Ans. 3456.

6. How many boxes of raisins, each 24 lbs. 8 ozs., can be filled out of 3 tons 17 cwts.? *Ans.* 352.

7. From 4 bales of cotton, each 4 cwts. 3 qrs. 15 lbs., how many yards can be woven, reckoning 12 ozs. 13 drs. to each yard?
Ans. 2732. +

8. How many gallons of train oil, each gallon weighing 7½ lbs., are there in 14 cwts. 2 qrs.? *Ans.* 216.

9. The middle arch of Southwark Iron Bridge weighs 1523 tons, how many half ounces? *Ans.* 109,168,640.

10. How many parcels of sugar of 2 lbs., 1 lb., ½ lb., ¼ lb. can be made out of a cask containing 8 cwts. 2 qrs. the number of each to be equal? *Ans.* 253. +

APOTHECARIES' WEIGHT.

1. In 3 lbs. 9 ℥. 4 ℨ. 2 ℈, how many grains? *Ans.* 21,880.

2. In 21,880 grains, how many pounds?
Ans. 3 lbs. 9℥. 4 ℨ. 2 ℈.

3. How many packages of 10 ℥. are there in 56 lbs. of bark?
Ans. 67. +

4. Required the difference in grains between 7 parcels, each weighing 4 lbs. 7 ℥. 3 ℨ., and 2 dozen of 11 ℥. 6 ℨ. 2 ℈, each?
Ans. 49,740.

CLOTH MEASURE.

1. In 764 nails, how many inches? *Ans.* 1719.

2. In 7591 yards, how many French ells? *Ans.* 5060. +

3. In 7596 quarters, how many Flemish ells? *Ans.* 2532.

4. In a piece of linen, measuring 21 English ells, how many shirts can be cut of 3¾ yards each? *Ans.* 7.

5. In 27 bales, each of 14 pieces, and each piece 21½ yds., how many Flemish ells? *Ans.* 10,836.

6. Required the difference in nails between 14 English ells and 19 French ells? *Ans.* 176.

7. How many suits can be made from a piece of cloth measuring $23\frac{1}{2}$ yds., reckoning a coat at $1\frac{3}{4}$ yd., trousers at 1 yd. 3 nls., and waistcoat at $\frac{1}{4}$ yd. 2 nls.? *Ans.* 7.+

LONG MEASURE.

1. In 6593 ft., how many furlongs? *Ans.* 9. +
2. In 97 miles, how many inches? *Ans.* 6,145,920.
3. In 6,145,920 inches, how many miles? *Ans.* 97.
4. From Dublin to Liverpool is 38 leagues, how many boats, each 21 ft. in length, would be required to form a line between the two places? *Ans.* 28,662.
5. How many barleycorns would reach round the world at the equator, which is equal to 360 degrees, each degree $69\frac{1}{2}$ miles? *Ans.* 4,755,801,600.
6. How many farthings would extend from the earth to the sun, which is 95 millions of miles distant, supposing 7 farthings equal to 6 inches? *Ans.* 7,022,400,000,000
7. In walking 16 miles, how many times does a walking-stick touch the ground, supposing it to do so at every third step, and each step to be 2 ft. 8 in.? *Ans.* 10,560.
8. The distance between London and Brighton is 52 miles, by how many revolutions do the fore wheels of the mail, which are 10 ft. in circumference, exceed those of the hind ones, which are $17\frac{1}{2}$ ft.? *Ans.* 11,767.

LAND MEASURE.

1. In 123 acres, how many perches? *Ans.* 19,680.
2. In 19,680 perches, how many acres? *Ans.* 123.
3. How many gardens of 16 poles 4 yards each, can be made from a field of 8 acres? *Ans.* 79. +
4. In 3 fields measuring respectively 3 a. 2 r. 14 po., 7 a. 3 r. 27 po., and 10 a. 1 r. 36 po., how many square inches? *Ans.* 137,880,468.
5. In a hide of land, how many allotments, each of 1 a. 2 r. 24 po.? *Ans.* 60. +
6. Three small farmers had each 7 acres; 20 cottagers, 1 a. 2 r. each; and 19 a. 3 r. 29 po. were occupied by 24 poor labourers: what was the whole content in perches? *Ans.* 11,349.

WINE MEASURE.

1. In a pipe of sherry, how many pints? *Ans.* 1008.
2. In 12,096 pints, how many puncheons? *Ans.* 18.

3. How many $1\frac{3}{4}$ pint bottles can be filled from a hogshead of brandy? *Ans.* 288.

4. In 4 tuns, 3 hhds., 51 gals., how many pints? *Ans.* 9984.

5. A pipe of port wine is to be drawn off into an equal number of quart, pint, and half-pint bottles, required the number of each? *Ans.* 288.

ALE AND BEER MEASURE.

1. In 416 hogsheads of porter, how many pints? *Ans.* 179,712.

2. In 300 barrels, how many hogsheads? *Ans.* 200.

3. How many pints in 864 butts? *Ans.* 746,496.

4. How many kilderkins in 843 butts? *Ans.* 5058.

5. How many 9 gal. casks can be filled out of 1 butt, 1 hhd., and 1 bar. of beer? *Ans.* 22.

6. In a butt of beer, how many tankards of 3 half-pints each? *Ans.* 576.

7. At two quarts of ale at dinner, and three pints at supper daily, how many days will a butt last a family? *Ans.* 128. +

DRY MEASURE.

1. In 276 quarters of corn, how many pecks? *Ans.* 8832.

2. In 607,842 gallons, how many quarters? *Ans.* 9497 qrs. 4 bush. 1 peck

3. In 3 lasts of barley, how many pints? *Ans.* 15,360.

4. How many horses would 7 lasts of oats feed, allowing half a peck to each? *Ans.* 4480.

5. How long will 10 tons of coal suffice for 3 fires, of which each burns 20 pounds daily? *Ans.* $373\frac{1}{3}$.

TIME.

1. In 15 hours, how many seconds? *Ans.* 54,000.

2. In seven years, how many hours? *Ans.* 61,362.

3. In 10 yrs. 3 mo. 21 days, how many hours? *Ans.* 90,324.

4. How many times does a clock strike in 4 years? *Ans.* 227,916.

5. From the birth of our Saviour to the end of the year 1832, how many seconds? *Ans.* 57,813,523,200.

6. From March 6 to December 27, how many hours? *Ans.* 7104.

7. If a person were to count 80 sovereigns per minute, and continue counting 12 hours each day, how many days would he be occupied in counting a million? *Ans.* 17 days 4 ho. 20 min.

This rule is used by artificers to measure their work. The dimensions are taken in feet, inches, and twelfths. A foot is divided into twelve parts called *inches* (in.), each inch into 12 parts, called *seconds* (″), each second into 12 parts called thirds (‴), and each *third* into 12 parts, called fourths (⁗), according to the following table :—

12 fourths (⁗) make 1 third.
12 thirds (‴) make 1 second.
12 seconds (″) make 1 inch.
12 inches make 1 foot.

The pupil must bear in mind, that

Feet multiplied by feet	give feet.
Feet multiplied by inches	give inches.
Feet multiplied by seconds	give seconds.
Inches multiplied by inches	give seconds.
Inches multiplied by seconds	give thirds.
Seconds multiplied by seconds	give fourths.

Rule.—Write the given numbers as in addition. Multiply the lowest name of the multiplicand by the highest name of the multiplier, then by the next lower names in succession, and add the products together.

Example.—Multiply 5 ft. 4½ in. by 6 ft. 8½ in.

Written thus

	5	4	3″
	6	8	6

32	1	6		top line multiplied by 6 feet.
3	6	10	0	top line multiplied by 8 inches.
	2	8	1	6 top line multiplied by 6 seconds.

35	11	0	1‴	6⁗	*Ans.*	

	ft.	in.		ft.	in.			ft.	in.			
Multiply	3	4	by	6	8		*Ans.*	22	2	8′		
	10	5	by	7	9		*Ans.*	80	8	9		
	9	7	by	11	6		*Ans.*	110	2	6		
	29	4	by	7	9		*Ans.*	227	4	0		
	14	3	6″ by	5	4		*Ans.*	76	2	8		
	18	5	3 by	6	3	8″	*Ans.*	116	3	1	3‴	
	8	7	1 by	3	2	6	*Ans.*	27	6	8	8	6⁗
	10	4	5 by	5	8	4	*Ans.*	59	0	5	9	8
	9	5	7 by	7	4	10	*Ans.*	70	0	9	11	10
	10	0	4 by	9	0	7	*Ans.*	90	8	10	2	4

For the application of this rule, see "Mensuration."

SIMPLE PROPORTION,

OR

THE RULE OF THREE.

By this rule a fourth number is found bearing the same proportion to a third number as exists between two other given numbers. In the proportion 1 : 2 : : 3 : 6, the six bears the same proportion to the three as the two does to the one; that is, two is twice one, and the fourth term must therefore be twice three.

In every proportion two terms are alike in kind, and the remaining term is of the same kind as the answer. Thus, in the question, If 1 lb. of grapes cost 2 shillings, what will 3 lbs. cost? the 1 lb. and 3 lbs. are of the same kind, that is, weight; and the 2 shillings the same kind as the answer, which is money.

RULE.—Put in the THIRD place that term which is of the same kind as the answer.

If the answer is to be greater than the third term, place the greatest of the remaining terms in the SECOND place. If the answer is to be less than the third term, put the least term in the SECOND place.

Put the remaining term in the FIRST place.

Multiply the second and third terms together, and divide by the first.

Observe:—The first and second terms must always be of the same name or denomination. This is effected by reducing both to the lowest name mentioned.

The division of this rule into *Direct* and *Inverse* is now generally rejected. The rule above includes both, and the

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Note 1.—In the Rule of Three Direct the third term is always *equal in value* to the first term, and the second term is *equal in value* to the answer.

Thus 3 lbs. are equal to 16½*d.*, and 24 lbs. are equal to 132*d.*

Note 2.—The *first* and *fourth* terms multiplied together are always equal to the product of the *second* and *third* terms. If, therefore, the second or third term be required, the product of the first and fourth terms divided by the remaining term will give it. If the first or fourth term be required, divide the product of the second and third terms by the given term.

division is therefore unnecessary; but as some teachers prefer making the distinction, we subjoin an instance of each kind.

When more requires more, or less requires less, as in the value of articles, &c., it is called

DIRECT PROPORTION.

Example.—If 3 lbs. of candles cost 16½*d.*, what cost 24 lbs.?

1st term.	2d term.	3d term.
As 3 lbs.	: 24 lbs.	:: 16½*d.*
	16½	
	3)396	
	132*d.*	

1st. I put the money, 16½*d.*, in the third place, because the answer is money.

2d. As the answer is to be greater than 16½*d.*, I place 24 lbs., the greater term, in the 2d place.

3d. I set down the remaining term, 3 lbs., in the first place.

When more requires less, or less requires more, as when more men are employed, the number of days required to perform the work is less; or, as when cloth is required to cover a space, the greater the breadth the less number of yards is required, it is called

INVERSE PROPORTION.

Example.—If 12 men work a mine in 18 days, in how many days will 24 do it?

1st term.	2d term.	3d term.
As 24 men	: 12 men	:: 18 days.
	18	
	24)216	
	9 days, 4th term.	

The answer is days; I therefore put 18 days for the 3d term.

The answer will be less than the 3d term, because 24 men will do more work than 12 men, therefore I put the least in the second place, and the remaining term in the first place.

Examples.

1. If a barrel of beer cost 2*l.* 10*s.*, what will a butt cost? *Ans.* 7*l.* 10*s.*

2. What will 12,000 quills cost, at 8½*d.* for 60? *Ans.* 7*l.* 1*s.* 8*d.*

3. At 10½*d.* per lb., what is the value of 7 cheeses, each weighing 26 lbs. 11 ozs.? *Ans.* 8*l.* 3*s.* 5½*d.*

4. How many yards of cloth can I have for 402*l.* 5*s.*, if 6 yards cost 1*l.* 8*s.* 8*d.*? *Ans.* 1683 yds. 3 qrs. 1

5. If 1 lb. of sugar cost $7\frac{1}{2}d.$, what will 10 cwts. 2 qrs. 16 lbs. come to? *Ans.* 37*l.* 5*s.*

6. A draper bought 20 pieces of cloth, each of 36 yards, at 3*l.* 15*s.* for 6 yards, what was the cost? *Ans.* 450*l.*

7. If an ounce of fine gold is sold for 3*l.* 10*s.*, what will 15 ingots come to, each weighing 14 lbs. 7 ozs. 3 dwts. 17 grs.? *Ans.* 9197*l.* 4*s.* $8\frac{1}{4}d.$

8. Five hogsheads of sugar, each weighing 7 cwts. 3 qrs. 27 lbs., at 3*l.* 10*s.* $10\frac{1}{2}d.$ per cwt.? *Ans.* 141*l.* 11*s.* 10*d.*

9. If 14 yards of cloth cost 16*s.* $9\frac{3}{4}d.$, what will $48\frac{1}{2}$ yards cost? *Ans.* 2*l.* 18*s.* $2\frac{3}{4}d.$

10. If 4 lbs. of soap cost 1*s.* 7*d.*, what cost 23 lbs.? *Ans.* 9*s.* $1\frac{1}{4}d.$

11. If 8*s.* $2\frac{1}{2}d.$ will buy 20 lbs. of sugar, how much will 2*s.* $10\frac{1}{2}d.$ buy? *Ans.* 7 lbs. +

12. If 4 yards of cotton cost 1*s.* 11*d.*, what will 100 yards come to? *Ans.* 2*l.* 7*s.* 11*d.*

13. If 3 lbs. of tobacco cost 11*s.* 5*d.*, what will 14 tons 17 cwts. 3 qrs. come to? *Ans.* 6345*l.* 7*s.* 8*d.*

14. How much will 3 nails of cloth come to at 4*s.* 7*d.* for 2 yds. 3 qrs.? *Ans.* $3\frac{3}{4}d.$

15. 1 yd. 1 nl. for 10*s.* $7\frac{1}{2}d.$, what cost 19 yds. 3 qrs.? *Ans.* 9*l.* 17*s.* 6*d*

16. From $14\frac{1}{2}$ cheeses, each weighing 14 lbs. 15 ozs., how many portions may be cut of $2\frac{1}{4}$ ozs. each? *Ans.* 1540. +

17. If 950*l.* will purchase 1000 yds., what is the price of 2 yds. 3 qrs.? *Ans.* 2*l.* 12*s.* 3*d.*

18. For 1*l.* 4*s.* $4\frac{1}{2}d.$ I can buy 3 qrs. of Dutch velvet; how many yards for 28*l.* 16*s.* $10\frac{1}{2}d.$ at that rate? *Ans.* 17 yds. 3 qrs.

19. Gold at $2\frac{1}{2}d.$ ger grain, what is the worth of 3 ozs. 15 dwts.? *Ans.* 18*l.* 15*s.*

20. What cost 3 ozs., at the rate of 76*l.* for 1 ton 17 cwts.? *Ans.* $\frac{3}{4}d.$ +

21. Wine at 50*l.* per pipe, what is it worth per bottle of 3 half pints? *Ans.* 1*s.* $5\frac{3}{4}d.$ +

22. If a bankrupt's estate pays 7*s.* 9*d.* in the pound, what is paid upon a debt of 1250*l.*? *Ans.* 484*l.* 7*s.* 6*d.*

23. How many ducats of 12*s.* each are equal in value to 1000 Chinsouree rupees of 1*s.* $10\frac{1}{2}d.$ each? *Ans.* 156, 3*s.* over.

24. If for 12*l.* 15*s.* a family of 10 persons is conveyed to Ostend, how many persons will 7*l.* 13*s.* pay for? *Ans.* 6.

25. How much in the pound does an insolvent pay whose effects amount to 827*l.* 14*s.* and his debts to 2136*l.*? *Ans.* 7*s.* 9*d.*

26. If a store of provisions be consumed by 15 men in 20 days, how long will a similar store last 10 men? *Ans.* 30.

27. Given in exchange 19 yds. 3 qrs. of cloth, at 11*s.* per yard, for 90 gallons of Scotch ale; required the price of the ale per firkin? *Ans.* 1*l.* 1*s.* 8½*d.*

28. A tradesman compounded with his creditors by paying them 6*s.* 3*d.* in the pound; what was lost on a debt of 7964*l.*?
Ans. 5475*l.* 5*s.*

29. If a stick 3 ft. high project a shadow of 2 ft. 8 in., what must be the height of a tower, whose shadow measures 74 feet?
Ans. 83 ft. 3 in.

30. If 64 yds. of carpet, 3 qrs. wide, cover a floor, how much of 5 qrs. wide will be sufficient? *Ans.* 38 yds. 1 qr. 2 nls.+

31. If a gentleman spends 19*s.* 6*d.* per day, and lays by 150*l.* at the year's end, what is his yearly income? *Ans.* 505*l.* 17*s.* 6*d.*

32. If 50 men build a wall in 24 days, how many men would build it in 9 days? *Ans.* 133.+

33. Borrowed 250*l.* for 10 months; how long ought I to lend 35*l.* to requite the kindness?
Ans. 2 yrs. 2 mo. 1 wk. 1 da. 20 ho. 12 min. 37 sec.

34. 74 men had provisions for 35 days; but after 5 days 20 men were sent away: how long will the provisions last the remaining 54 men? *Ans.* 41 days.

35. What is the whole worth of a ship, three-tenths of which cost 525*l.*? *Ans.* 1750*l.*

36. A rate of 279*l.* 10*s.* is to be made for the poor on a parish which yields a rental of 7850*l.*, what is the rate per pound?
Ans. 8½*d.*

37. If a gentleman be taxed 37*l.* 0*s.* 10*d.* at 7*d.* in the pound, what is his rental? *Ans.* 1270*l.*

38. How many yards of paper 3 qrs. wide will be sufficient for a room of 210 square yards? *Ans.* 280.

39. If a man complete a journey of 25 days at 9 hours' walking each day, how long would he have been if he had travelled 13 hours a day? *Ans.* 17 days.+

40. How much plank of 8 inches wide will be sufficient to floor a room 21 ft. by 12 ft.? *Ans.* 378 ft.

41. If 14 yds. of cloth 1¼ yd. wide suffice for 5 suits how many 3 qrs. wide would be required? *Ans.* 23⅓ yds.+

42. A tea-dealer bought 5 chests of tea, weighing 57 lbs. 7½ oz. each for 57*l.* 11*s.* 8¼*d.*; what did it cost per half ounce? *Ans.* 1½*d.*

43. If for 7*l.* 10*s.* I have 10 cwt. 3 qrs. carried 47 miles, how far can I have 2 tons carried at the same cost?
Ans. 12 miles 5 fur.

44. What is the value of 17 ingots of gold, each weighing 10 lbs. 1 oz. 10 dwts., at 19*d.* for 15 dwts.? *Ans.* 213*l.* 0*s.* 6*d.*

COMPOUND PROPORTION,

OR

THE DOUBLE RULE OF THREE,

Is the union of several questions of Simple Proportion in one question, having the third term common to all. The third term is always the same in kind as the answer.

RULE.—Put in the THIRD place the term which is of the same kind as the answer.

Proceed with each pair of terms exactly as in Simple Proportion.

Multiply all the first terms together for a general first term, and all the second terms together for a general second term.

Multiply the second and third terms together, and divide by the first term.

Example.—If 4 men earn 12 shillings in 7 hours, how long will 14 men be earning 30 shillings? *Example:*

14	:	4	: :	7	:	
12	:	30	: :	—	:	
168	:	120	: :	7	:	

7

168)840(5

840

7 hours in the third term, because it is of the same kind as the answer. 4 men and 14 men being a pair of terms, are placed according to the Rule of Simple Proportion: that is, as the answer would be *less* than the third term, the least of the two terms is placed second, and the remaining one in the first place. 12 shillings and 30 shillings being another pair, are placed by the same rule, the *greater* in the second place. Then by multiplying the two first terms, 14 and 12, together, the general FIRST term is obtained, and by multiplying 4 and 30 together the general SECOND term is found, and the statement becomes, as 168 are to 120 so are 7 to the answer, as seen above.

CANCELLING.

The operation may be sometimes shortened by drawing a line and placing all the first terms below it, and all the second and third terms above it, and dividing any two of them, *of opposite sides*, by any number which will divide both without a remainder.

Placed thus, $\frac{4}{14} \quad \frac{30}{12} \quad \frac{7}{\quad}$, the numbers 14 and 4 being both

divisible by 2 without a remainder, will be reduced to 7 and 2; and 12 and 30 being divisible by 6, will be altered to 2 and 5

The question then stands $\frac{2 \quad 5 \quad 7}{7 \quad 2}$. Again, the 7 above and the 7 below being *on opposite sides*, destroy each other, as do also the 2 above and the 2 below. The only remaining figure, 5, will therefore be the answer.

Exercises.

1. If 4 men earn 12*s.* in 7 hours, how long will 14 men be earning 30*s.*? *Ans.* 5 hours.

2. If 12 cows produce 240 lbs. of butter in 4 weeks, how many cows may be supposed to yield 20 lbs. in 1 week? *Ans.* 4.

3. If 4 cows produce 20 lbs. in 1 week, how much will 12 cows produce in 4 weeks? *Ans.* 240 lbs.

4. If the carriage of 4 cwts. 20 miles come to 6*s.* what will 17 cwts. 60 miles? *Ans.* 3*l.* 16*s.* 6*d.*

5. If 3*l.* 16*s.* 6*d.* pay for the carriage of 17 cwts. 60 miles, what weight can be carried 20 miles for 6*s.*? *Ans.* 4 cwt.

6. If 30 acres of grass be mown by 6 men in 5 days, how many acres can be mowed by 50 men in 20 days? *Ans.* 1000.

7. If 1000 acres be mown by 50 men in 20 days, how many men will mow 30 acres in 5 days? *Ans.* 6.

8. If 187*l.* 10*s.* pay for the education of 20 boys for half a year, how many can be educated for 150*l.* for 1 year? *Ans.* 8.

9. If 150*l.* pay for 8 boys for a year, what will be the expense for 20 boys half a year? *Ans.* 187*l.* 10*s.*

10. If 3*l.* 10*s.* are given for the loan of 100*l.* for a year, how much ought to be paid for the use of 312*l.* 10*s.* for 1 year, 35 weeks, and 5 days? *Ans.* 18*l.* 8*s.* $6\frac{3}{4}$*d.*

11. A park wall, 1236 yards in length, was to have been built by 60 men in 21 days; but at the end of 15 days, finding only 824 yards completed, how many more must be employed to finish it in the given time? *Ans.* 15 extra.

12. A man and his son, earning 9*s.* per day working together, had a piece of work to complete for 5*l.* 8*s.*; but at the end of 6 days, the father being taken ill, how long was the son finishing it by himself, supposing he worked but half as fast as his father? *Ans.* 18 days.

13. If a canal 1500 yards long, 6 yards wide, and 3 yards deep be dug in 30 days of 12 hours each, by 280 men, how many men would be required to dig another canal 3 miles long, 4 yards wide, and 2 yards deep, in 125 days of 10 hours each? *Ans.* 126.

TARE AND TRET.

TARE *is an allowance made to buyers for the weight of packages containing the goods sold.*

TRET *is an allowance of* 4 *lbs. in* 104 *lbs. for waste, dust, &c.*

CLOFF *is an allowance of* 2 *lbs. for every* 3 *cwt. to the retailer for loss in weighing.*

GROSS WEIGHT *is the whole weight, including packages, &c.*

NETT WEIGHT *is when all allowances are deducted.*

SUTTLE *is when part of the allowance is taken from the gross.*

When the tare is so much on the whole weight, to find the nett weight:

RULE.—Subtract the tare from the gross weight, and the remainder is the nett weight.

When the tare is at so much per box, bag, &c.

RULE.—Multiply the tare by the number of packages, and subtract the product from the gross weight; the remainder is the nett weight.

Example.—7 hhds. of sugar, weighing gross 14 cwts. 2 qrs. 19 lbs.; tare 1 qr. 14 lbs. per hhd.

cwt.	qr.	lbs.		cwt.	qr.	lbs.	
0	1	14	tare.	14	2	19	
		7	No. of hhds.			7	
2	2	14		102	2	21	gross wt.
				2	2	14	tare of 7 hhds.
				100	0	7	nett wt. of 7 hhds.

When the tare is so much per cwt.:

RULE.—Divide the weight by the aliquot parts of a cwt., and subtract as before.

Example.—What is the nett weight of 24 tubs of butter, weighing 1 cwt. 19 lbs. each, tare 14 lbs. per cwt.?

		cwt.	qr.	lbs.	
		1	0	19	
				24	
Tare per cwt. 14 lbs.	$\frac{1}{8}$	28	0	8	gross weight.
		3	2	1	
		24	2	7	nett weight.

When tret is allowed, divide what remains after tare is deducted (which is called the *suttle*) by 26; because 4 lbs. are the 26th part of 104 lbs.

Example.—What is the nett weight of 6 bags of hops, each weighing 2 cwt. 1 qr. 4 lbs., tare 28 lbs. per cwt., and tret allowed 4 lbs. in 104 lbs.

		cwt.	qrs.	lbs.	
		2	1	4	
				6	
Tare per cwt. 28 lbs.	$\frac{1}{4}$	13	2	24	gross weight.
		3	1	20	tare.
	$\frac{1}{26}$	10	1	4	suttle.
		0	1	16	tret.
		9	3	16	nett.

Cloff is seldom allowed: to find it multiply the tret suttle by 2, and divide it by 3; the quotient will be the lbs. cloff, which subtract as before.

Exercises.

1. Gross weight of a box of ginger 24 lbs., tare 4½ lbs.; how many pounds nett? *Ans.* 19½ lbs.

2. A jar of figs, gross weight 19 lbs., tare 4¼ lbs.: how many lbs. nett? *Ans.* 14¾ lbs.

3. Gross weight 2 cwt. 19 lbs., tare 2 qrs. 9 lbs.?
Ans. 1 cwt. 2 qrs. 10 lbs.

4. Gross weight 16 cwt., tare 1 cwt. 2 qrs. 18 lbs.?
Ans. 14 cwt. 1 qr. 10 lbs.

5. Gross weight of 7 bales 33 cwt. 3 qrs. 18 lbs., tare per bale ¾ cwt.? *Ans.* 28 cwt. 2 qrs. 18 lbs.

6. Gross weight of 10 boxes 56 cwt. 1 qr. each, tare per box 24 lbs.? *Ans.* 560 cwt. 1 qr. 12 lbs.

7. Gross weight of 25 hhds. 18 cwt. 3 qrs. 7 lbs. each, tare per hhd. 1 cwt. 7½ lbs.? *Ans.* 443 cwt. 2 qrs. 15½ lbs.

8. Gross weight of 19 bags 12 cwt. 1 qr. 4 lbs. each, tare per bag, 15 lbs., tret allowed? *Ans.* 222 cwt. 0 qr. 1 lb.

9. Gross weight of 26 casks 145 cwt., tare per cask 1 cwt. 18 lbs., tret allowed? *Ans.* 110 cwt., 21 lbs.

10. 7 butts, each 12 cwt., tare 2 qrs. per butt, tret allowed?
Ans. 77 cwt. 1 qr. 17¼ lbs.

11. 18 chests, each 1 cwt. 15 lbs., tare 15 lbs. per chest, tret allowed? *Ans.* 17 cwt. 1 qr. 7 lbs.

A TABLE OF ALIQUOT PARTS OF MONEY, WEIGHTS, AND MEASURES.

Of a Penny.

$\frac{1}{4}d.$	... is ...	$\frac{1}{4}$	
$\frac{1}{2}$	... „ ...	$\frac{1}{2}$	

Of a Shilling.

$1d.$	... is ...	$\frac{1}{12}$	
$1\frac{1}{2}$	... are ...	$\frac{1}{8}$	
2	... „ ...	$\frac{1}{6}$	
3	... „ ...	$\frac{1}{4}$	
4	... „ ...	$\frac{1}{3}$	
6	... „ ...	$\frac{1}{2}$	

Of a Pound Troy.

6 oz.	... are ...	$\frac{1}{2}$	
4	... „ ...	$\frac{1}{3}$	
3	... „ ...	$\frac{1}{4}$	
2	... „ ...	$\frac{1}{6}$	
1 oz. 10 dwts.	are	$\frac{1}{8}$	
1	... is ...	$\frac{1}{12}$	

Of an Ounce Troy.

10 dwts.	are ...	$\frac{1}{2}$	
6 dwts. 16 gr.		$\frac{1}{3}$	
5	... „ ...	$\frac{1}{4}$	
4	... „ ...	$\frac{1}{5}$	
3 dwts. 8 gr.	...	$\frac{1}{6}$	
2 dwts. 12 gr.		$\frac{1}{8}$	
2	... „ ...	$\frac{1}{10}$	
1 dwt. 16 grs.		$\frac{1}{12}$	

Of an Acre.

2 r.	... are ...	$\frac{1}{2}$	
1	... is ...	$\frac{1}{4}$	
20 p.	... are ...	$\frac{1}{8}$	
16	... „ ...	$\frac{1}{10}$	

Of a Pound.

$1d.$	... is ...	$\frac{1}{240}$	
$1\frac{1}{2}$	... are ...	$\frac{1}{160}$	
2	... „ ...	$\frac{1}{120}$	
3	... „ ...	$\frac{1}{80}$	
$3\frac{3}{4}$	... „ ...	$\frac{1}{64}$	
4	... „ ...	$\frac{1}{60}$	
5	... „ ...	$\frac{1}{48}$	
6	... „ ...	$\frac{1}{40}$	
$7\frac{1}{2}$	... „ ...	$\frac{1}{32}$	
8	... „ ...	$\frac{1}{30}$	
10	... „ ...	$\frac{1}{24}$	

Of a Ton.

10 cwt.	are ...	$\frac{1}{2}$	
5	... „ ...	$\frac{1}{4}$	
4	... „ ...	$\frac{1}{5}$	
2	... „ ...	$\frac{1}{10}$	
1	... is ...	$\frac{1}{20}$	

Of a Cwt.

2 qrs.	are ...	$\frac{1}{2}$	
1	... is ...	$\frac{1}{4}$	
16 lbs.	are ...	$\frac{1}{7}$	
14	... „ ...	$\frac{1}{8}$	
8	... „ ...	$\frac{1}{14}$	
7	... „ ...	$\frac{1}{16}$	
$3\frac{1}{2}$	... „ ...	$\frac{1}{32}$	
2	... „ ...	$\frac{1}{56}$	
$1\frac{3}{4}$	... „ ...	$\frac{1}{64}$	

Of a Yard.

2 qrs.	... are ...	$\frac{1}{2}$	
1 qr.	... is ...	$\frac{1}{4}$	
2 nails	are ...	$\frac{1}{8}$	
1 nail	... is ...	$\frac{1}{16}$	

Of a Pound.

1s.	... is ...	$\frac{1}{20}$	
1s. 3d.	are	$\frac{1}{16}$	
1s. 4d.	„ ...	$\frac{1}{15}$	
1s. 8d.	„ ...	$\frac{1}{12}$	
2s.	... „ ...	$\frac{1}{10}$	
2s. 6d.	„ ...	$\frac{1}{8}$	
3s. 4d.	„ ...	$\frac{1}{6}$	
4s.	... „ ...	$\frac{1}{5}$	
5s.	... „ ...	$\frac{1}{4}$	
6s. 8d.	„ ...	$\frac{1}{3}$	
10s.	... „ ...	$\frac{1}{2}$	

Of $\frac{1}{2}$ cwt. or 56 lb.

28 lbs.	... are ...	$\frac{1}{2}$	
14	... „ ...	$\frac{1}{4}$	
8	... „ ...	$\frac{1}{7}$	
7	... „ ...	$\frac{1}{8}$	

Of $\frac{1}{4}$ cwt. or 28 lb.

14 lbs.	... are ...	$\frac{1}{2}$	
7	... „ ...	$\frac{1}{4}$	
4	... „ ...	$\frac{1}{7}$	
$3\frac{1}{2}$	... „ ...	$\frac{1}{8}$	

Of a lb. Avoir.

8 oz.	... are ...	$\frac{1}{2}$	
4	... „ ...	$\frac{1}{4}$	
2	... „ ...	$\frac{1}{8}$	
1	... is ...	$\frac{1}{16}$	

Of an English ell.

2 qr.	2 nl.	are ...	$\frac{1}{2}$	
1	1	„ ...	$\frac{1}{4}$	
1	0	is ...	$\frac{1}{5}$	
0	5	are ...	$\frac{1}{4}$	

THE ANSWERS TO THE QUESTIONS IN THIS RULE WILL BE FOUND IN THE COMPOUND ADDITION SUMS ACCORDING TO THEIR NUMBERED ORDER, pages 26. 27.

THE METHOD OF COMPUTING BY ALIQUOT PARTS.

CASE 1.—*When the price is less than a penny.*

RULE.—Divide by the aliquot* parts of a penny, and then by 12 and 20.

Ex.

d.		
½	½	4128 at ½*d.*
	12	2064 = value in pence.
	2|0	17|2 = value in shillings.
		£8 12 0 *Ans.*

(1) 7919 at ¼
(2) 7695 at ½
(3) 6547 at ¾
(4) 4573 at ¾

CASE 2.—*When the price is less than a shilling.*

RULE.—Take the aliquot parts of a shilling, and divide by 20.

Example.

d.		
3	¼	2416 at 3½*d.*
½	⅙	604 = at 3*d.* each.
		100 8 = at ½*d.* each.
	2|0	70|4 8 = at 3½*d.*
		£35 4 8

	d.		d.		d.
	7547 at 1	(20)	2107 at 4¾		2915 at 8½
	3751 at 1¼		8037 at 5		5107 at 8¾
	54325 at 1½		2715 at 5¼		2184 at 9
	6254 at 1¾		6287 at 5½		6325 at 9¼
	2351 at 2		7521 at 5¾		5189 at 9½
(10)	7210 at 2¼		15042 at 6	(40)	6847 at 9¾
	2401 at 2½		7914 at 6¼		2165 at 10
	3250 at 2¾		3520 at 6½		3501 at 10¼
	2715 at 3		1354 at 6¾		8209 at 10½
	3531 at 3¼		1483 at 7		7291 at 10¾
	2147 at 3½	(30)	1627 at 7¼		5063 at 11
	1750 at 3¾		2701 at 7½		7313 at 11¼
	3752 at 4		3333 at 7¾		1877 at 11½
	4209 at 4¼		1355 at 8		7972 at 11¾
	7051 at 4½		5707 at 8¼		3986 at 11¾

*Aliquot is that part which divides a number without a remainder.

CASE 3.—*When the price exceeds* 12 *pence, and is under* 2 *shillings.*

RULE.—Take the aliquot parts of a shilling, as in Case 2, and add the top line and divide by 20 as before.

Example.

d.		
3	$\frac{1}{4}$	3245 at 1*s.* $3\frac{1}{2}d$
$\frac{1}{2}$	$\frac{1}{6}$	811 3
		135 $2\frac{1}{2}$
2	0	4191 $5\frac{1}{2}$

£209 11 $5\frac{1}{2}$

	s.	d.		s.	d.		s.	d.
2106 at		$12\frac{1}{4}$	3270 at	1	$4\frac{1}{4}$	9847 at	1	$8\frac{1}{4}$
3715 at		$12\frac{1}{2}$	7059 at	1	$4\frac{1}{2}$	6319 at	1	$8\frac{1}{2}$
5424 at		$12\frac{3}{4}$	2750 at	1	$4\frac{3}{4}$	8614 at	1	$8\frac{3}{4}$
4214 at	1	1	(70) 3728 at	1	5	9299 at	1	9
3215 at	1	$1\frac{1}{4}$	7250 at	1	$5\frac{1}{4}$	9991 at	1	$9\frac{1}{4}$
2791 at	1	$1\frac{1}{2}$	2597 at	1	$5\frac{1}{2}$	9475 at	1	$9\frac{1}{2}$
682 at	1	$1\frac{3}{4}$	7210 at	1	$5\frac{3}{4}$	8313 at	1	$9\frac{3}{4}$
7500 at	1	2	7524 at	1	6	(90) 4734 at	1	10
3291 at	1	$2\frac{1}{4}$	7103 at	1	$6\frac{1}{4}$	6001 at	1	$10\frac{1}{4}$
(60) 9255 at	1	$2\frac{1}{2}$	3254 at	1	$6\frac{1}{2}$	4889 at	1	$10\frac{1}{2}$
7250 at	1	$2\frac{3}{4}$	7925 at	1	$6\frac{3}{4}$	7631 at	1	$10\frac{3}{4}$
7591 at	1	3	9271 at	1	7	8454 at	1	11
6325 at	1	$3\frac{1}{4}$	8325 at	1	$7\frac{1}{4}$	8631 at	1	$11\frac{1}{4}$
5271 at	1	$3\frac{1}{2}$	(80) 9483 at	1	$7\frac{1}{2}$	9631 at	1	$11\frac{1}{2}$
3254 at	1	$3\frac{3}{4}$	9738 at	1	$7\frac{3}{4}$	9733 at	1	$11\frac{3}{4}$
2915 at	1	4	4789 at	1	8			

CASE 4.—*When the price is an even number of shillings.*

RULE.—Multiply by half the price, double the product of the first figure, and take it for shillings; the remainder as pounds.

Example. 4016 at 8*s.*
4

£1606 8*s. Ans.*

	s.		s.
3479 at	2	3473 at	10
4184 at	4	9344 at	16
(100) 9363 at	6	4741 at	14
7214 at	8	8496 at	18

CASE 5.—*When the price is odd shillings.*
RULE.—Multiply by the price, and divide by 20.

Example. 1274 at 7*s.*

7

2|0)891|8

£445 18*s.* *Ans.*

s.	s.	s.
1440 at 1	8463 at 7	7214 at 15
1764 at 3	(110) 6431 at 9	9142 at 17
3412 at 5	4341 at 13	2847 at 19

CASE 6.—*When the price is any amount of shillings which is an aliquot part of a pound sterling.*
RULE.—Divide by the aliquot part.

Example. s.

10	½	5174 at 10*s.*

£2587 *Ans.*

3344 at 1 3	5425 at 2 6
9541 at 1 4	8376 at 3 4
3847 at 1 8	(120) 9942 at 6 8

CASE 7.—*When the price is shillings and pence, which are not aliquot parts of a pound.*
RULE.—Multiply by the shillings, take parts for the pence and farthings, as in Case 2, add them together, and divide by 20.

Example.

d.		
6	½	4204 at 4*s.* 7½*d.*
		4
		16816 = at 4*s.*
1½	¼	2102 = at 6*d.*
		525 6 = at 1½*d.*
	2|0	1944|3 6 = at 4*s.* 7½*d.*

£972 3 6 *Ans.*

	s.	d.			s.	d.			s.	d.
3143 at	1	7½		1309 at	7	6¼		5055 at	17	1½
1976 at	11	8		9241 at	9	6½		9142 at	17	6
1844 at	13	4	(130)	3473 at	13	3¾		5877 at	18	4¼
6885 at	10	7½		8571 at	14	2½		9941 at	18	3¼
9654 at	11	4		6345 at	13	5½		8814 at	18	9
1565 at	9	7½		9144 at	16	8	(140)	9111 at	19	8¼
4263 at	12	0¼		8473 at	16	9½				

Case 8.— *When the price is pounds, shillings, pence, and farthings.*

Rule.—Multiply by the pounds and take aliquot parts for the rest; or multiply by the whole number of shillings contained in the pounds and shillings, and take parts for the pence.

Example.

s.		
5	¼	6008 at 4*l.* 5*s.* 6½*d.*
		4
		24032
6	1/10	1502
½	1/12	150 4
		12 10 4
		£25696 14 4 *Ans.*

	£	s.	d.			£	s.	d.
9876 at	1	3	4		9933 at	4	14	4½
9834 at	1	18	9		9642 at	7	16	3
2437 at	1	3	3¼		8183 at	9	6	9⅓
4229 at	1	15	9¾		8671 at	9	6	4¼
6543 at	8	1	8		9377 at	3	17	5½
7654 at	3	4	7		4452 at	4	11	3
1742 at	7	1	8		7633 at	4	5	10½
7463 at	8	1	4		9888 at	6	3	6
8341 at	4	3	4		5679 at	9	1	4½
(150) 8283 at	9	9	10½	(160)	1749 a	7	17	6⅔

CASE 9.—*When the quantity and the price are both of several denominations.*

RULE.—Multiply the price by the number in the quantity of the highest name, and take parts for the rest.

Example.—5 cwts. 2 qrs. 8 lbs. at 3*l.* 4*s.* 2*d.*

qrs.		£	s.	d.	
2	½	3	4	2	
				5	the highest name is cwts.
		16	0	10	value of 5 cwts.
8	¼	1	12	1	value of 2 qrs.
			4	7	value of 8 lbs.
		17	17	6	value of 5 cwts. 2 qrs. 8 lbs.

	tons	cwts.	qrs.	lbs.	oz.		£	s.	d.	
			2	16		at	1	8	3	per cwt.
		2	1	3		at	1	10	6¼	—
		1	2	7		at	3	1	1½	—
		4	3	15		at	5	2	6	—
		17	3	14		at	3	17	6	—
		5	3	10		at	1	2	6	—
		17	1	16		at	3	2	8¼	—
		6	1	11		at	2	10	0	—
		12	2	8		at	5	2	8	—
(170)		19	3	17	8	at	217	0	0	—
		37	3	14		at	2	4	4	—
		32	1	17		at	1	12	4	—
	4	17	3	14		at	32	14	0	per ton.
		14	3	17		at	3	14	6	per cwt.
		19	3	14		at	2	14	6	—
		74	3	14		at	2	4	6	—
	5	17	3	14		at	5	10	4	per ton.
		33	1	14		at	2	3	6	per cwt.
		3	0	27		at	2	16	4½	—
	158	17	2	9	10	at	500	0	0	per ton.

INTEREST

INTEREST is a sum of money paid for the use of money borrowed. The money borrowed is called THE PRINCIPAL, and the sum paid for the loan of each hundred pounds is called THE RATE PER CENT.

PER is a Latin word meaning *by* or *for*, and CENT. is a contraction of the Latin word *Centum*—a hundred. PER CENT. is therefore, literally, by the hundred, or for the hundred. If £100 be borrowed, and £5 be paid for the loan of it for a year, we say that the £100 has been lent at the Rate of 5 per Cent. per Annum.

			£	£	s.	d.
5 per cent.	is	$\frac{1}{20}$th of	100	= 5	0	0
4 „		$\frac{1}{25}$th of	100	= 4	0	0
2½ „		$\frac{1}{40}$th of	100	= 2	10	0
1 „		$\frac{1}{100}$th of	100	= 1	0	0

DISCOUNT—means sometimes merely money deducted, but it is really the difference between the full amount of a Debt and its present worth.

In paying Tradesmen's Accounts a Discount is usually taken off for pre-payment of 2½ per cent., and sometimes more for other reasons.

			£		s.	d.	
2½ per cent.	is	$\frac{1}{40}$ of	1	or	0	6	for each pound.
5 „		$\frac{1}{20}$ of	1	or	1	0	„
10 „		$\frac{1}{10}$ of	1	or	2	0	„
12½ „		$\frac{1}{8}$ of	1	or	2	6	„
25 „		$\frac{1}{4}$ of	1	or	5	0	„
50 „		$\frac{1}{2}$ of	1	or	10	0	„

In Commission, Purchasing of Stocks, &c., very small sums are paid as per centage. A Broker, for instance, charges $\frac{1}{8}$th per cent. for buying or selling £100 stock in the public funds.

			£		£	s.	d.
$\frac{1}{8}$th per cent.	being	$\frac{1}{8}$th of	1	will be	0	2	6
$\frac{1}{4}$ „		$\frac{1}{4}$ of	1	„	0	5	0
$\frac{3}{8}$ „				„	0	7	6
$\frac{5}{8}$ „				„	0	17	6
$\frac{7}{8}$ „				„	1	12	6

SIMPLE INTEREST.

Interest is money paid for the use of money.
The Principal is the money lent.
The Rate per cent. is the sum paid for the loan of 100*l.*
The Amount is the principal and interest added together.

CASE 1.—*To find the interest for years.*

RULE.—Multiply the principal by the rate per cent.; divide the product by 100, the quotient is the interest for 1 year; multiply by the given number of years.

Example.—What is the interest of 425*l.* for 4 years, at 5 per cent. per annum?

£	£	s.	d.
425	21	5	0 interest for 1 year.
5 rate per cent.		4	
21,25	85	0	0 interest for 4 years, at 5 per cent.
20 shillings.			
5,00			

If the years and rate multiplied together make an aliquot part of 100, divide by that part. In this instance $4 \times 5 = 20 = \frac{1}{5}$ of 100; therefore $425 \div 5 = 85l.$ *Ans.*

1. What is the interest of 764*l.* for 4 years, at 5 per cent. per annum? *Ans.* 152*l.* 16*s.*
2. What is the interest of 276*l.* 10*s.* for $3\frac{1}{2}$ years, at 4 per cent. per annum? *Ans.* 38*l.* 14*s.* $1\frac{3}{4}d.$
3. What is the interest of 327*l.* 16*s.* 8*d.* for 7 years, at $4\frac{1}{2}$ per cent. per annum? *Ans.* 103*l.* 5*s.* $3\frac{1}{2}d.$
4. What is the interest of 7000*l.* for 3 years, at $2\frac{1}{2}$ per cent. per annum? *Ans.* 525*l.*
5. What is the interest of 619*l.* 17*s.* 6*d.* for $7\frac{1}{2}$ years, at 4 per cent. per annum? *Ans.* 185*l.* 19*s.* $2\frac{1}{4}d$
6. What is the amount of 840*l.* 16*s.* 6*d.* for 3 years, at 5 per cent. per annum? *Ans.* 966*l.* 18*s.* $11\frac{1}{4}d.$
7. What is the amount of 2743*l.* 19*s.* 6*d.* for $2\frac{1}{2}$ years, at 6 per cent. per annum? *Ans.* 3155*l.* 11*s.* $4\frac{1}{2}d.$
8. Required the amount of 1749*l.* 12*s.* 8*d.* for $3\frac{1}{4}$ years, at 4 per cent. per annum? *Ans.* 1977*l.* 1*s.* $7\frac{3}{4}d.$
9. Required the amount of 500*l.* for $9\frac{3}{4}$ years, at $4\frac{1}{2}$ per cent. per annum? *Ans.* 719*l.* 7*s.* 6*d.*

CASE 2.—*To find the interest for weeks and days.*

RULE.—If they form an aliquot part of a year, divide the interest of one year by that aliquot part. If they do not form an aliquot part, reduce the weeks and days to days, and say, as 365 days are to the number of days, so is 1 year's interest to the interest required.

Example.—What is the interest of 300*l.* at 5 per cent. for 3 years 73 days?

	days.		£	
300	73	$\frac{1}{5}$	15	interest for 1 year.
5			3	
15,00			45	interest for 3 years.
			3	interest for 73 days.
			48	interest for 3 years 73 days.

OR, As 365 : 73 :: 15*l.* :
15

365) 1095 (3*l.* interest for 73 days.
1095

. . .

1. What is the interest of 100*l.* for 27 weeks 3 days, at 5 per cent. per annum? *Ans.* 2*l.* 12*s.* 7*d.*

2. What is the interest of 230*l.* 10*s.* for 220 days, at 4 per cent. per annum? *Ans.* 5*l.* 11*s.* $1\frac{1}{2}$*d.*

3. What is the amount of 297*l.* 15*s.* 6*d.* for 12 weeks 4 days, at $3\frac{1}{2}$ per cent. per annum? *Ans.* 300*l.* 5*s.* 9*d.*

4. Find the interest of 250*l.* for 26 weeks 5 days, at 4 per cent. per annum. *Ans.* 5*l.* 2*s.* $5\frac{1}{2}$*d.*

5. What is the amount of 362*l.* 12*s.* 9*d.* from July 7th to Nov. 28th following, at 5 per cent. per annum? *Ans.* 369*l.* 15*s.* $9\frac{3}{4}$*d.*

6. What is the amount of 726*l.* 15*s.* at 4 per cent. per annum, for 3 years 19 weeks 4 days? *Ans.* 824*l.* 17*s.* $4\frac{3}{4}$*d.*

7. What is the interest of 1000*l.* at $4\frac{1}{2}$ per cent. per annum for 7 years 21 weeks 3 days? *Ans.* 333*l.* 9*s.* $10\frac{1}{4}$*d.*

8. What is the amount of 795*l.* 13*s.* 4*d.* at $3\frac{1}{2}$ per cent. for 6 years 247 days? *Ans.* 981*l.* 11*s.* $11\frac{3}{4}$*d*

9. What is the interest of 697*l.* 18*s.* 6*d.* from Jan. 3rd to Nov. 27th, 1832, at $4\frac{1}{2}$ per cent. per annum? *Ans.* 28*l.* 6*s.* 2*d*

COMMISSION

Is an allowance to a factor, broker, or agent, on account of goods bought or sold for his employer.

RULE.—Divide the sum bought or sold by 100, which gives 1 per cent.; multiply or divide this sum according to the rate allowed, as in the rule of Practice.

1. What is the commission on 5000*l.* at 5*s.* or $\frac{1}{4}$ per cent.?
Ans. 5000*l.* divided by 100 gives 50*l.* × $\frac{1}{4}$ per cent. = 12*l.* 10*s.* for commission.
2. What is the commission on 2814*l.* 10*s.* at 10*s.* per cent.?
Ans. 14*l.* 1*s.* 5$\frac{1}{4}$*d.*
3. What do I pay to a broker at $\frac{3}{8}$ per cent. for 11,250*l.*?
Ans. 42*l.* 3*s.* 9*d.*
4. What is the factorage on goods sold to the amount of 15,000*l.* at 5*s.* 9*d.* per cent.? *Ans.* 43*l.* 2*s.* 6*d.*
5. At 3*l.* 4*s.* 2*d.* per cent. what is the commission for 584*l.* 10*s.*?
Ans. 18*l.* 15*s.* $\frac{1}{4}$*d.*
6. At 5$\frac{1}{8}$ commission, what must I pay for 327*l.* 15*s.* 4*d.*?
16*l.* 18*s.* 7$\frac{1}{2}$*d.*

INSURANCE.

To find at a certain rate what sum must be paid for protection from loss by fire or other accidents.

RULE.—Calculate as in Commission if there be no time given. If time be given, calculate as in Interest.

1. What is the insurance at 5*s.* per cent. on 8000*l.*? *Ans.* 20*l.*
2. What is the insurance at 17*s.* 9*d.* on 4182*l.* 10*s.*?
Ans. 37*l.* 2*s.* 4$\frac{1}{2}$*d.*
3. What must I pay for an insurance of 2000*l.* for 3 years, 2 months, 10 days, at 2$\frac{1}{2}$ per cent. per annum?
Ans. 159*l.* 14*s.* 5$\frac{1}{4}$*d.*
4. What is the insurance on 745*l.* for 37 years, 3 months, 13 days, at 1$\frac{7}{8}$ per cent.? *Ans.* 520*l.* 16*s.* 9$\frac{1}{2}$*d.*

STOCKS

Are public funds. The value of a nominal 100*l. is sometimes above and sometimes below* 100*l.; to find its exact value is the object of this rule. If more, it is called above par; if less, below par.* PAR *here, therefore, means* 100*l.*

RULE.—Multiply by the rate per cent., and divide by 100, as in Simple Interest.

In transfering stock, brokers charge $\frac{1}{8}$ per cent.

1. What is the value of 300*l.* of the 3 per cent. stock, at 81 per cent.? *Ans.* 243*l.*

2. What must be paid for 1000*l.* stock at 95$\frac{1}{3}$? *Ans.* 953*l.* 6*s.* 8*d.*

3. What is the value of 500*l.* Bank stock at 215*l.* per cent.? *Ans.* 1075*l.*

4. Value of 7000*l.* East India stock at 197$\frac{3}{8}$*l.* per cent.? *Ans.* 13,816*l.* 5*s.*

5. What must be paid for the purchase of 10,000*l.* stock at 105$\frac{3}{4}$ per cent., and the broker's commission at $\frac{1}{8}$ per cent.? *Ans.* 10,587*l.* 10*s.*

REBATE OR DISCOUNT

IS AN ALLOWANCE MADE UPON THE PAYMENT OF A DEBT BEFORE IT IS DUE.

CASE 1.—*To find the discount and present value.*

RULE.—As 100*l.*, *with its interest* for the given time, is to the debt, so is that interest to the discount, which, deducted from the debt, leaves the present value.

Example.—Find the discount and present value of 250*l.* due in 9 months, at 5 per cent. per annum.

	£	s.	
To	100	0	
Add	3	15	= interest for 9 months.

Debt. Interest. Discount.

First,—As 103*l.* 15*s.* : 250*l.* :: 3*l.* 15*s.* : 9*l.* 0*s.* 8$\frac{1}{2}$*d.*

Then 9*l.* 0*s.* 8$\frac{1}{2}$*d.* taken from 250*l.* leaves 240*l.* 19*s.* 3$\frac{1}{2}$*d.*, its present value.

1. What is the present value of 320*l.* due in 4 months, allowing 6 per cent. per annum? *Ans.* 313*l.* 14*s.* 6$\frac{1}{4}$*d.*

2. What is the present value of 420*l.* due in 9 months, at 4$\frac{1}{2}$ per cent. per annum? *Ans.* 406*l.* 5*s.* 9$\frac{1}{4}$*d.*

3. What money will discharge a debt of 247*l.* 15*s.* due 8 months hence, at 3$\frac{1}{2}$ per cent. per annum? *Ans.* 242*l.* 2*s.* $\frac{1}{4}$*d.*

4. What discount must be allowed upon 627*l.* due in 240 days, at 10 per cent. per annum? *Ans.* 38*l.* 13*s.* 7$\frac{1}{2}$*d.*

5. Required the present value of a debt of 536*l.* half of which is to be paid in 3 months, and the remainder in 6 months, allowing 6 per cent. per annum? *Ans.* 524*l.* 4*s.* 8$\frac{1}{4}$*d.*

CASE 2.—*When the amount, that is, the debt and interest, is given, to find the time.*

RULE.—As the interest of the debt for a year is to the whole interest, so is one year to the time required.

Example.—How long will a debt of 200*l.* be in amounting to 250*l.* at 4 per cent. per annum?

Interest of Debt.		Whole Interest.		Year.		Answer.
As 8*l.*	:	50*l.*	::	1	:	6 yrs. 91¼ days

1. In what time will 270*l.* amount to 300*l.* at 5 per cent.?
Ans. 2 years, 81 days.
2. How long will 360*l.* be in amounting to 500*l.* at 3 per cent.?
Ans. 12 years, 351 days
3. In what time will 726*l.* amount to 826*l.* at 4½ per cent.?
Ans. 3 years, 22 days.
4. How long will 520*l.* be in amounting to 636*l.* at 10 per cent.?
Ans. 2 years, 84 days.
5. How long will 1000*l.* be in amounting to 1000 guineas at 2½ per cent.? *Ans.* 2 years.

CASE 3.—*The amount and time being given, to find the rate per cent.*

RULE.—As the debt is to 100*l.*, so is the interest for the given time to the interest of the same, which divided by the time gives the rate per cent.

Example.—At what rate per cent. will 450*l.* amount to 522*l.* in 4 years?

Debt.			Int.	Int.	Yrs.	
As 450*l.*	:	100*l.*	::	72*l.*	:	16*l.* ÷ 4 = 4 per cent., *Ans.*

1. At what rate per cent. will 640*l.* amount to 697*l.* 12*s.* in 3 years?
Ans. 3 per cent.
2. At what rate per cent. will 380*l.* amount to 494*l.* in 5 years?
Ans. 6 per cent.
3. At what rate per cent. will 400*l.* amount to 480*l.* in 4 years?
Ans. 5 per cent.
4. At what rate per cent. will 510*l.* 12*s.* 6*d.* amount to 513*l.* 15*s.* 4*d.* in 8 weeks?
Ans. 4 per cent.

COMPOUND INTEREST

IS INTEREST ON INTEREST AS WELL AS UPON PRINCIPAL.

RULE.—Find the interest for 1 year, which add to the principal; take that amount as the principal of the second year, find the interest as before, and continue to add each year's interest for the time given.

Subtract the principal from the last amount, and the difference will be the compound interest.

Example.—What will be the compound interest of 200*l.* for 3 years, at 5 per cent. per annum?

5 per cent. = $\frac{1}{20}$)	200	0	0	= 1st year's principal.
Add	10	0	0	= interest.
$\frac{1}{20}$)	210	0	0	= 2d year's principal.
Add	10	10	0	= interest.
$\frac{1}{20}$)	220	10	0	= 3d year's principal.
Add	11	0	6	= interest.
	231	10	6	= amount in 3 years.
Deduct	200	0	0	= principal.
Ans.	31	10	6	= compound interest for 3 yrs.

1. What will be the compound interest of 500*l.* for 4 yrs. at 5 per cent. per annum? *Ans.* 107*l.* 15*s.* $\frac{3}{4}$*d.*

2. What will 350*l.* amount to in 3 yrs. at 6 per cent. per annum, compound interest? *Ans.* 416*l.* 17*s.* 1*d.*

3. What will be the compound interest of 625*l.* for $2\frac{1}{2}$ years at 3 per cent. per annum? *Ans.* 48*l.* 0*s.* 2*d.*

4. What is the amount of 250*l.* for 7 years 3 months, at $4\frac{1}{2}$ per cent. per annum, compound interest? *Ans.* 344*l.* 0*s.* $9\frac{1}{2}$*d.*

5. What will be the compound interest of 650*l.* for 4 years 9 months, at $3\frac{1}{2}$ per cent. per annum? *Ans.* 115*l.* 9*s.* 4*d.*

6. What will 1000 guineas amount to in 5 years, at $4\frac{1}{2}$ per cent. per annum, compound interest? *Ans.* 1308*l.* 9*s.* $9\frac{1}{2}$*d.*

7. Required the compound interest of 820*l.* for 4 yrs. at $3\frac{3}{4}$ per cent. per annum? *Ans.* 130*l.* 1*s.* $10\frac{1}{4}$*d.*

8. What will 750*l.* amount to in 5 years 6 months 15 days, at 6 per cent. per annum, compound interest? *Ans.* 1036*l.* 5*s.* $8\frac{1}{4}$*d.*

BARTER.

In trade it frequently happens that one tradesman buys goods of another, and, instead of paying money for them, gives other goods in return: this is called *Barter*. The rule, therefore, shows how much of any article at a certain price should be given for any quantity at a different price.

Thus, if a person has a number of books to sell at 6*d*. each, and he wants quills for them at 5*s*. per hundred, the rule tells him how many books he should give for the quills.

RULE.—Find the worth of the given article either by the Rule of Three or Practice, according to the nature of the question, and then, by one or the other of those rules, find what quantity of the other article this sum will purchase.

Example.—How much coffee at 3*s*. per lb. can I have to barter for 27 lbs. of tea, at 6*s*. per lb.?

3*s*. : 6*s*. :: 27 lbs.

6

3)162

54 lbs.

1. How much chocolate at 4*s*. 6*d*. per lb. must be given for 2 cwts. 2 qrs. 19 lbs. of sugar at 8*d*. per lb.? *Ans.* 44 lbs. 4 ozs. 11 drs.

2. How much tea at 9*s*. must be given for 90 pairs of stockings, at 3*s*. per pair? *Ans.* 30 lbs.

3. What quantity of coals at 30*s*. per ton must be given for 400 deal boards at 18*s*. per dozen? *Ans.* 20 tons.

4. How much snuff at 4*s*. 6*d*. per lb. must be given for 2 cwts. 3 qrs. of tobacco, at 6*l*. per cwt.? *Ans.* 73⅓ lbs.

5. How many lbs. of currants at 12*d*. per lb. must be given for 5 cwts. 3 qrs. 9 lbs. of plums at 6*d*.? *Ans.* 326 lbs. 8 ozs.

6. A linendraper and cheesemonger barter; the cheesemonger has 40 cwts. of cheese at 21*s*. 6*d*. per cwt., and the linendraper has 16 pieces of Irish cloth, at 3*l*. 15*s*. per piece; what is the difference in value? * *Ans.* 17*l*.

7. A bookseller has 1216 copies of a work worth 14*s*. per copy for which a grocer sends him 85 cwts. 2 qrs. 24 lbs. of sugar; what was the sugar valued at per cwt.? *Ans.* 9*l*. 18*s*. 7½*d*.

* If the articles exchanged are not of equal value, the difference must be paid in money.

PROFIT AND LOSS.

THIS RULE SHOWS WHAT IS LOST OR GAINED IN BUYING AND SELLING GOODS.

RULE.—Subtract the cost price from the selling price, and multiply the remainder by the total quantity.

Example.—Bought 12 yds. of cloth at 7*s.* 9*d.* per yd.; if I sell it at 10*s.* 6*d.*, what shall I gain by the whole?

s.	d.	
10	6	
7	9	
2	9	gain per yard.
	12	yards.
£1	13	0 gain for the whole.

1. Bought 76 yds. of muslin at 11*s.* 8*d.* per yd., sold it at 14*s.* 2*d.*; what was the gain upon the whole? *Ans.* 9*l.* 10*s.* 0*d.*

2. Bought 205 pairs of stockings, at 15*d.* per pair, sold the whole for 10*l.* 5*s.*; what was the loss? *Ans.* 2*l.* 11*s.* 3*d.*

3. Bought 137 lbs. of chocolate at 4*s.* 1½*d.* per lb., sold it at 1*s.* 9*d.* per lb.; what was the gain? *Ans.* 4*l.* 5*s.* 7½*d.*

4. If a man buys tobacco at 5*l.* 15*s.* per cwt., and sells 25 cwts. 2 qrs. for 150*l.* 8*s.*, does he gain or lose? *Ans.* 3*l.* 15*s.* 6*d.* gain.

5. If a publican buys ale at 3*l.* per barrel, and retails it at 8*d.* per quart, what does he gain by selling 25 barrels?

Ans. 45*l.* 0*s.* 0*d.*

6. If the brewing of 17,482 gallons of beer cost 987*l.*, what must it be sold at per gallon to clear 250*l.* by it? *Ans.* 1*s.* 4¾*d.*+

OF GAIN PER CENT.

Per cent. means per 100*l.*; therefore, if you are required to find the gain or loss per cent., it means the gain or loss in laying out 100*l.* To find which work by the Rule of Three.

Example.—If a draper buys cloth at 1*s.* 6*d.* per yd., and sells it again for 2*s.* 3*d.*, what does he gain per cent.?

Here the gain per yard being found by subtraction, the question is thus stated:—

s. d. d. £.
If 1 6 gains 9, what will 100 gain?

Money expended. Gain.
Or, As 18*d.* : 100*l.* :: 9*d.* : 50*l.*

1. A druggist buys gum at 5*s.* 9*d.* per lb.; what must he sell it at per lb. to gain 20 per cent.? *Ans.* 6*s.* $10\frac{3}{4}d.$

2. A draper buys cloth at 8*s.* 2*d.* per yard, and sells it at 8*s.* $10\frac{1}{2}d.$; what is the gain per cent.? *Ans.* 8*l.* 13*s.* $5\frac{1}{2}d.$

3. If 800 bales, of 1 cwt. each, cost 23*l.* 10*s.* per bale, what should it be sold at per lb. to gain $7\frac{1}{2}$ per cent.? *Ans.* 4*s.* 6*d.*+

4. If 7 cwts. 2 qrs. 15 lbs. of sugar cost 25*l.* 19*s.* 10*d.*, what must it be sold at per lb. to gain 15 per cent.? *Ans.* $8\frac{1}{4}d.$

PARTNERSHIP, OR FELLOWSHIP,

IS A RULE BY WHICH PERSONS TRADING WITH A JOINT STOCK ASCERTAIN THEIR SHARES OF GAIN OR LOSS.

CASE 1.—*Fellowship without time.*

RULE.—*As* the whole stock *is to* the whole gain or loss, *so is* each man's stock *to* his share of gain or loss.

Example.—A. B. and C. began trade with 1000*l.*; A. gave 200*l.*, B. 300*l.*, and C. 500*l.*; they gained 250*l.* What was each man's share of the gain?

		Whole stock.		Whole gain.		A's stock.		A's gain.
A. 200	Then A.	As 1000	:	250	::	200	:	50
						B's stock.		B's gain.
B. 300	B.	As 1000	:	250	::	300	:	75
						C's stock.		C's gain.
C. 500	C.	As 1000	:	250	::	500	:	125
1000								

1. A. and B. commenced trade with 20,000*l.* of which A. furnished 12,000*l.*; they gained 1800*l.*; what was each man's share of the profit? *Ansrs.* A. 1080*l.*—B. 720*l.*

2. Divide 1000*l.* among three persons, so that for every 2*l.* A. has, B. shall divide 3*l.* and C. 5*l.*

Ansrs. A. 200*l.*—B. 300*l.*—C. 500*l.*

3. Three persons traded in wines, and freighted a ship with 800 pipes, of which A. sent 140, B. 310, and C. the remainder; a storm arising, 70 pipes were thrown overboard; how much will each lose? *Ans.* A. $12\frac{6}{24}$; B. $27\frac{3}{24}$; C. $30\frac{15}{24}$.

4. A bankrupt owed to V. 470*l.* 10*s.*, to W. 1090*l.*, to Y. 715*l.* 8*s.* 3*d.*, to Z. 153*l.* 15*s.*; his property amounted only to 1200*l.*, what did each receive?

Ans. V. 232*l.* 7*s.* $6\frac{1}{2}d.$+; W. 538*l.* 6*s.* 11*d.*+; Y. 353*l.* 6*s.* $9\frac{1}{4}d.$ +; Z. 75*l.* 18*s.* $8\frac{3}{4}d.$+

5. A ship worth 10,000*l.* was lost belonging to 4 persons; to F. $\frac{1}{8}$, to G. $\frac{1}{8}$, to H. $\frac{1}{4}$, and to K. $\frac{1}{2}$; she was insured for 4500*l.* what will each receive, and how much will each lose?

Ans. Receive, F. 562*l.* 10*s.*; G. 562*l.* 10*s.*; H. 1125*l.* 0*s.* K. 2250*l.* 0*s.*—Lose, F. 687*l.* 10*s.*; G. 687*l.* 10*s.*; H. 1375*l.* 0*s.*; K. 2750*l.* 0*s.*

PARTNERSHIP WITH TIME, OR DOUBLE FELLOWSHIP,

IS WHEN THE SHARES ARE SUBSCRIBED FOR DIFFERENT PERIODS OF TIME.

RULE.—Multiply each man's money by his time, and proceed as in Partnership without time.

Ex.—Three persons join. K. put in 250*l.* for 9 months, L. 580*l.* for 10 months, and M. 1500*l.* for 8 months; they cleared 400*l.*; what is each man's share of the gain?

			Whole Amount.	Whole Gain.	Stock.
K.	250 × 9 = 2250	Then K. As	20050	: 400 ::	2250
L.	580 × 10 = 5800	L. As	20050	: 400 ::	5800
M.	1500 × 8 = 12000	M. As	20050	: 400 ::	12000
	20050				

1. F. and G. enter into partnership; F. puts in 587*l.* 10*s.* for 12 months, G. 3180*l.* for 7 months; they clear 350*l.*; what is each one's gain? *Ans.* F. 84*l.* 3*s.* $8\frac{1}{2}$*d.*—G. 265*l.* 16*s.* $3\frac{1}{4}$*d.*

2. Two graziers hired a piece of land for 80*l.*; F. put in 50 sheep to graze for 5 months, G. 200 sheep for 3 months; what has each to pay? *Ans.* F. 23*l.* 10*s.* $7\frac{1}{4}$*d.*—G. 56*l.* 9*s.* $4\frac{3}{4}$*d.*

3. Three merchants put their money together; X. 2400*l.* for 18 months, Y. 1850*l.* for 12 months, and Z. 940*l.* for 9 months; they cleared 3460*l.*; required each one's share of the gain?

Ans. X. 2023*l.* 14*s.* $4\frac{3}{4}$*d.*—Y. 1039*l.* 19*s.* 4*d.*—Z. 396*l.* 6*s.* $2\frac{3}{4}$*d.*

4. Four persons speculated; A. with 740*l.* for three months, B. 670*l.* for four months, C. 354*l.* for 11 months, and D. 500*l.* for 15 days; they gained 1000*l.*; what was each man's gain?

Ans. A. 245*l.* 9*s.* $3\frac{3}{4}$*d.*—B. 296*l.* 6*s.* $6\frac{3}{4}$*d.*—C. 430*l.* 11*s.* $2\frac{3}{4}$*d.*—D. 27*l.* 12*s.* 10*d.*

FRACTIONS.*

A fraction is a part. A farthing or a halfpenny is a fraction of a penny, a penny is a fraction of a shilling, and a shilling of a pound, because they are parts. If a slate be broken into several pieces, each piece is a fraction, and all the fractions or pieces added together are and must be just equal to the whole slate. See the Fractograph.

Fractions are written in two ways. The one way with two numbers, as $\frac{3}{4}$, and is called Vulgar Fractions; the other with a single number, and a point or comma before it, as ·75 and is called Decimals. Each of these fractions, $\frac{3}{4}$ and ·75, stands for three quarters.

Vulgar Fractions are used for common purposes; but for computations of annuities, measuring of land, timber, haystacks, canals, or geometrical figures, for astronomical and other scientific calculations—

Decimals are used, because of their requiring but one number instead of two, and being consequently more readily multiplied and divided.

Decimal Fractions are always tenths; the decimal ·4 means four tenths, $\frac{4}{10}$. Decimals may always be made Vulgar Fractions by drawing a line under them and putting a nought under each figure and 1 before the noughts; the decimal ·325 is made a Vulgar Fraction by writing it thus, $\frac{325}{1000}$. Some portions of a number cannot be expressed by a decimal, as $\frac{1}{3}$, one-third, but any part may be exactly expressed by a Vulgar Fraction. The parts of the broken slate, or fractograph, for instance, could not be expressed decimally except they were all exact tenth parts; but any parts might be expressed by Vulgar Fractions, as $\frac{1}{3}$ one-third, $\frac{3}{7}$ three-sevenths, $\frac{1}{917}$ one-nine hundred and seventeenth, which cannot be expressed in Decimals.

If fractions could be avoided the arithmetician would be saved some labour, but they are indispensable, for the following reasons among many others: — If a ship or speculation be divided into shares of $\frac{1}{4}$, $\frac{1}{16}$, $\frac{2}{15}$, $\frac{3}{10}$, &c., the holders of the shares may like to sell $\frac{1}{3}$ of the share $\frac{1}{4}$, $\frac{1}{2}$ of $\frac{3}{16}$, $\frac{2}{3}$ of $\frac{2}{15}$, or $\frac{3}{4}$ of the share $\frac{3}{10}$. If the ship be sold, or a profit be made of 10,000*l.*, a knowledge of fractions is necessary to ascertain how much money is due to each

* Fraction is from the Latin word *fractus*, broken; hence also fracture, &c.

owner. If a room is to be carpeted of 23 ft. $9\frac{3}{4}$ in. long, and 18 ft. $4\frac{1}{2}$ in. broad, an acquaintance with fractions is necessary to know how much carpeting $\frac{3}{8}$ of a yard wide will cover it.

The rules which apply to whole numbers apply equally to fractions. It is as necessary to add, subtract, multiply, and divide them as to do so with whole numbers; but as they are variously written, it is often necessary to alter their form and reduce them to a similarity of expression; thus, if I have to add together $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, I must first find how many twelfth parts there are in each fraction, and then it will be easy to do so; $\frac{1}{2}$ is equal to 6 twelfths $\frac{6}{12}$, $\frac{2}{3}$ are equal to 8 twelfths $\frac{8}{12}$, and $\frac{3}{4}$ are equal to 9 twelfths $\frac{9}{12}$; I therefore say, $\frac{6}{12}$, $\frac{8}{12}$, and $\frac{9}{12}$, are equal to $\frac{23}{12}$, twenty three twelfths. This change of fractions is called Reduction of Fractions, and the various methods used to produce this change are called cases or rules of Reduction.

VULGAR FRACTIONS.

A Vulgar Fraction is always expressed by two numbers, placed one above the other, with a line between them. The *upper* number is called the *Numerator*, the *lower* the *Denominator*.

The denominator shows how many parts the whole number is divided into; the numerator shows the number of parts taken: thus, in $\frac{1}{2}d.$ the lower figure, the denominator, shows that the penny is to be divided into 2 parts, and the upper figure shows that 1 of the two parts is to be taken. $\frac{9}{12}$ means that the thing is divided into 12 parts, and 9 parts are to be taken. If, therefore, the thing divided be a shilling, $\frac{9}{12}$ will be equal to 9 pence, because the $\frac{1}{12}$ part of a shilling is one penny.

A *simple fraction* has one numerator and one denominator.

A *compound fraction* consists of two or more simple fractions, with the word *of* between each, as $\frac{1}{2}$ of $\frac{4}{5}$ of 6.

A *proper fraction* has the numerator less than the denominator.

An *improper fraction* has the numerator equal to or greater than the denominator; as $\frac{5}{5}$, $\frac{8}{5}$.

A whole number and a fraction together are called a *mixed number*, as $2\frac{5}{8}$.

REDUCTION.

CASE 1.—*To find a number which will divide both the numerator and denominator without a remainder, so as to reduce the fraction to its lowest terms.*

RULE.—Divide the lower term by the upper, and that divisor by the remainder, continuing the operation till nothing remains; the last divisor is the number sought.

Example.—Reduce $\frac{24}{64}$ to its lowest terms.

24) 64 (2
48
—
16) 24 (1
16
—
8) 16 (2
16

Thus 8, being the last divisor, is the common divisor; $8)\frac{24}{64} = \frac{3}{8}$, the least terms.

Reduce $\frac{15}{180}$ to its lowest terms. *Ans.* $\frac{1}{12}$.
Reduce $\frac{46}{115}$ to its lowest terms. *Ans.* $\frac{2}{5}$.
Reduce $\frac{8255}{19220}$ to its lowest terms. *Ans.* $\frac{55}{128}$.
Reduce $\frac{55}{9900}$ to its lowest terms. *Ans.* $\frac{1}{180}$.
Reduce $\frac{45}{10000}$ to its lowest terms. *Ans.* $\frac{9}{2000}$.

CASE 2.—*To reduce a compound fraction to a simple one.*

RULE.—Multiply all the numerators together for a new numerator, and all the denominators together for a new denominator. Reduce it to its lowest terms, by Case 1.

Example.—Reduce $\frac{1}{2}$ of $\frac{5}{6}$ of $\frac{10}{15}$ of 8 to a simple fraction.

Ans. $\frac{1}{2}\times\frac{5}{6}\times\frac{10}{15}\times\frac{8}{1}=\frac{400}{180}=\frac{40}{9}$.

Reduce $\frac{4}{5}$ of $\frac{7}{8}$ of $\frac{5}{19}$ to a simple fraction. *Ans.* $\frac{140}{760}$.
Reduce $\frac{9}{19}$ of $\frac{3}{7}$ of $\frac{5}{11}$ to a simple fraction. *Ans.* $\frac{135}{1463}$.
Reduce $\frac{3}{5}$ of $\frac{12}{75}$ of $\frac{1}{2}$ of 10 to a simple fraction. *Ans.* $\frac{360}{750}$.
Reduce $\frac{1}{3}$ of $\frac{7}{14}$ of $\frac{5}{8}$ of 1*l.* to a simple fraction. *Ans.* $\frac{35}{288}l.$

CASE 3.—*To reduce fractions to a common denominator.*

RULE.—Multiply each numerator into all the denominators, except its own, for a new numerator; and all the denominators together for a new denominator.

Example.—Reduce $\frac{3}{8}$ and $\frac{4}{10}$ to a common denominator.

$3\times10=30$
$4\times\ 8=32$

$8\times10=80$

$\frac{30}{80}=\frac{3}{8}$, $\frac{32}{80}=\frac{4}{10}$. *Ans*

Reduce $\frac{5}{6}$, $\frac{3}{10}$, and $\frac{9}{21}$, to a common denominator.

Ans. $\frac{1050}{1260}$, $\frac{378}{1260}$, $\frac{540}{1260}$.

Reduce $\frac{4}{11}$, $\frac{7}{6}$, $\frac{15}{16}$, and $\frac{1}{2}$, to a common denominator.

Ans. $\frac{768}{2112}$, $\frac{2464}{2112}$, $\frac{1980}{2112}$, $\frac{1056}{2112}$.

Reduce $\frac{3}{7}$, $\frac{14}{15}$, $\frac{3}{7}$, and $\frac{4}{5}$, to a common denominator.

Ans. $\frac{1575}{3675}$, $\frac{3430}{3675}$, $\frac{1575}{3675}$, $\frac{2940}{3675}$.

Reduce $\frac{7}{11}$, $\frac{1}{9}$, $\frac{17}{15}$, and $\frac{12}{15}$, to a common denominator.

Ans. $\frac{17010}{26730}$, $\frac{2970}{26730}$, $\frac{25245}{26730}$, $\frac{23166}{26730}$.

CASE 4.—*To reduce an improper fraction to an equivalent whole or mixed number.*

RULE.—Divide the numerator by the denominator.

Example.—Reduce $^{1520}/_{15}$ to a whole or mixed number.

Ans. $1520 \div 15 = 101\frac{5}{15}$.

Find the value of $^{48}/_{3}$ in whole numbers. *Ans.* 16.

Find the value of $^{1263}/_{7}$ in whole numbers. *Ans.* $180\frac{3}{7}$.

Find the value of $^{1960}/_{20}$ in whole numbers. *Ans.* 98.

Find the value of $^{80457}/_{77}$ in whole numbers. *Ans.* $104\frac{37}{77}$.

CASE 5.—*To reduce a mixed number to an improper fraction.*

RULE.—Multiply the *whole* number by the denominator of the fraction, add to it the numerator, and place the denominator below it.

Example.—Reduce $12\frac{4}{5}$ to an improper fraction.

Ans. $12 \times 5 + 4 = \frac{64}{5}$.

Reduce $10\frac{7}{8}$, $15\frac{4}{7}$, $80\frac{4}{17}$, $33\frac{2}{3}$, $45\frac{7}{11}$, $100\frac{2}{9}$, to improper fractions.

Ans. $\frac{87}{8}$, $\frac{109}{7}$, $\frac{1364}{17}$, $\frac{101}{3}$, $\frac{502}{11}$, $\frac{902}{9}$

CASE 6.—*To reduce fractions of one denomination to fractions of greater denomination, retaining the same value.*

RULE.—Multiply the denominator as in reduction of money.

Example.—Reduce $\frac{2}{3}$ of a penny to the fraction of a pound sterling; that is, find what proportion of a pound $\frac{2}{3}$ of a penny is.

$$\text{Ans. } 3 \times 12 \times 20 = \frac{2}{720}$$

Reduce $\frac{5}{8}$ of a shilling to the fraction of a pound sterling.

Ans. $\frac{5}{160}$.

Reduce $\frac{4}{5}$ of a yard to the fraction of a mile. *Ans.* $\frac{4}{8800}$.

Reduce $\frac{9}{10}$ of 1 lb. to the fraction of 1 cwt. *Ans.* $\frac{9}{1120}$.

Reduce $\frac{2}{7}$ of a gallon to the fraction of a butt. *Ans.* $\frac{2}{756}$.

Reduce $\frac{7}{12}$ of an inch to the fraction of a mile. *Ans.* $\frac{7}{760320}$.

CASE 7.—*To reduce fractions of one denomination to a less denomination.*

RULE.—Multiply the numerator as in reduction of money

Example.—Reduce $\frac{3}{10}$ of a pound sterling to the fraction of a farthing. *Ans.* $3 \times 20 \times 12 \times 4 = 2880$. —— 10 —— 10

Reduce $\frac{5}{11}$ of a pound sterling to the fraction of 1*d.* *Ans.* $\frac{1200}{11}$.
Reduce $\frac{4}{7}$ of a guinea to the fraction of a shilling. *Ans.* $\frac{84}{7}$.
Reduce $\frac{3}{10}$ of a cwt. to the fraction of 1 lb. *Ans.* $\frac{336}{10}$.
Reduce $\frac{5}{7}$ of a mile to the fraction of an inch. *Ans.* $\frac{31680}{7}$.
Reduce $\frac{3}{4}$ of a ton to the fraction of an ounce. *Ans.* $\frac{107520}{4}$.

CASE 8.—*To reduce a complex fraction to an equivalent simple one.*

RULE.—If the numerator, or denominator, or both, contain a whole number, reduce it to an improper fraction; then multiply the denominator of the lower fraction into the numerator of the upper, *for a new numerator;* and multiply the denominator of the upper fraction into the numerator of the lower *for a new denominator.*

Example.—Reduce $\frac{5}{\frac{7}{8}}$ to a simple fraction.

$\frac{5}{\frac{7}{8}} = \frac{40}{7}$ because $\frac{5 = \frac{5}{1}}{\frac{7}{8} = \frac{7}{8}}$; then $\begin{matrix} 5 \times 8 = 40 \\ 7 \times 1 = 7 \end{matrix}$

Reduce $\frac{5}{9\frac{1}{4}}$ to a simple fraction. *Ans.* $\frac{40}{37}$.

Reduce $\frac{8}{19\frac{3}{7}}$ to a simple fraction. *Ans.* $\frac{56}{136}$.

Reduce $\frac{4\frac{7}{8}}{11}$ to a simple fraction. *Ans.* $\frac{39}{88}$.

Reduce $\frac{5\frac{3}{10}}{12}$ to a simple fraction. *Ans.* $\frac{53}{120}$.

Reduce $\frac{8\frac{4}{5}}{10\frac{5}{7}}$ to a simple fraction. *Ans.* $\frac{308}{375}$.

Reduce $\frac{7\frac{3}{8}}{8\frac{5}{6}}$ to a simple fraction. *Ans.* $\frac{354}{412}$.

CASE 9.—*To find the value of a fraction.*

RULE.—Multiply the numerator by so many of the less

as make one of the greater, as in reduction of money, and divide by the denominator.

Example.—What is the value of $\frac{9}{10}$ of a pound sterling?

$9s. \times 20s. \div 10s. = 18s.$ *Ans.*

What is the value of $\frac{1}{3}$ of a mile? *Ans.* 2 fur. 26 po. 3 yd. 2 ft.

What is the value of $\frac{3}{5}$ of a guinea? *Ans.* $12s.\ 7d.+$

What is the value of $\frac{2}{9}$ of a cwt.? *Ans.* 24 lbs. 14 ozs. 3 drs.+

What is the value of $\frac{4}{7}$ of an acre? *Ans.* 91 po.+

What is the value of $\frac{3}{4}$ of $\frac{5}{6}$ of a sovereign? *Ans.* $12s.\ 6d.$

CASE 10.—*To reduce a given quantity to its equivalent fractional part of any other denomination.*

RULE.—Reduce the given quantity to the lowest term mentioned for a numerator, then bring the denomination the fraction is to be of, to the same name for a denominator.

Example.—Reduce $12s.\ 6\frac{1}{2}d.$ to the fraction of $1l.$

$12s.\ 6\frac{1}{2}d.$ = 602 farthings which is the numerator, and the number of farthings in a pound is 960, therefore the answer is $\frac{602}{960}$.

Reduce $5s.\ 8\frac{1}{4}d.$ to the fraction of a pound sterling. *Ans.* $\frac{273}{960}$.

Reduce $17s.\ 6\frac{1}{2}d$ to the fraction of a farthing. *Ans.* $\frac{842}{1}$.

Reduce $3s.\ 11\frac{3}{4}d.$ to the fraction of a penny. *Ans.* $\frac{191}{4}$.

Reduce 3 qrs. 14 lbs. to the fraction of 1 cwt. *Ans.* $\frac{98}{112}$.

Reduce 5 cwts. 1 qr. 17 lbs. to the fraction of a ton. *Ans.* $\frac{605}{2240}$.

Reduce $3s.\ 3\frac{3}{4}d.$ to the fraction of a crown. *Ans.* $\frac{159}{240}$.

Reduce 4 po. 3 yds. 2 ft. to the fraction of an acre. *Ans.* $\frac{1118}{43560}$.

Reduce 14 gals. 2 qts. 1 pt. to the fraction of a hhd. of beer. *Ans.* $\frac{117}{432}$.

Reduce 3 wks. 4 ds. 17 hrs. to the fraction of a lunar month. *Ans.* $\frac{617}{672}$.

Reduce a life of 28 years 4 m. 3 wks. 5 ds. to the fraction of a century. *Ans.* $\frac{10837425}{36525}$.

ADDITION.

RULE.—Reduce the fractions to a common denominator, add all the numerators together, and place the common denominator under them.

Example.—Add together $\frac{4}{5}$ and $\frac{5}{6}$.

$4\times6=24$
$5\times5=25$ $= \frac{24}{30} \times \frac{25}{30} = \frac{49}{30}$ *Ans.* $1\frac{19}{30}$.

$5\times6=30$

Add together $\frac{2}{5}$, $\frac{7}{8}$, and $\frac{9}{10}$. *Ans.* $2\frac{76}{40}$.

Add together $\frac{5}{11}$, $\frac{3}{14}$, $\frac{7}{9}$, and $\frac{8}{9}$. *Ans.* $2\frac{4185}{1274}$.

Add together $\frac{4}{7}$, $8\frac{1}{3}$, and $\frac{9}{5}$. *Ans.* $10\frac{74}{105}$.

Add together $59\frac{1}{7}$, $\frac{2}{3}$ of $\frac{3}{4}$, $\frac{1}{2}$, and $5\frac{7}{8}$. *Ans.* $65\frac{11}{168}$.

When the fractions are of several denominations, reduce them to their simple values, and then add them together.

Example.—To $\frac{5}{6}$ of 1*l.* sterling add $\frac{3}{12}$ of a shilling.

	s.	d.
$\frac{5}{6}$ of 1*l.* =	16	8
$\frac{3}{12}$ of 1*s.* =	0	3
Ans.	16	11.

To $\frac{5}{8}$ of 1*l.* add $\frac{3}{4}$ of a shilling, and $\frac{2}{3}$ of sixpence. *Ans.* 13*s.* 7*d.*

Add $\frac{3}{10}$ of a ton to $\frac{4}{9}$ of 1 cwt.

Ans. 6 cwt. 1 qr. 21 lbs. 12 oz. 7 drs. +.

What is the amount of $\frac{1}{7}$ of a guinea, $\frac{7}{10}$ of a sovereign, and $\frac{3}{5}$ of a shilling? *Ans.* 7*s.* $3\frac{1}{4}$*d.*+

Add $\frac{4}{11}$ of a chaldron of coals to $\frac{2}{5}$ of a bushel. *Ans.* $14\frac{1}{5}$ bush.

Add together $4\frac{1}{5}$*l.*, $\frac{4}{5}$ of $\frac{7}{8}$ of a shilling, and $\frac{1}{8}$ of a penny.

Ans. 4*l.* 3*s.* $6\frac{1}{4}$*d.*

SUBTRACTION.

Rule.—Reduce them to a common denominator and subtract one from the other.

Example.—From $\frac{11}{12}$ take $\frac{4}{9}$.

$$11 \times 9 = 99 = \frac{99}{108} - \frac{48}{108} = \frac{51}{108}. \text{ Ans.}$$
$$4 \times 12 = 48$$
$$12 \times 9 = 108$$

From $\frac{5}{11}$ take $\frac{14}{87}$. *Ans.* $\frac{281}{957}$.

From $2\frac{4}{7}$ take $\frac{3}{5}$ of $\frac{4}{7}$ of 1. *Ans.* $2\frac{56}{245}$.

From $19\frac{4}{5}$ take $\frac{1}{3}$ of $\frac{2}{4}$ of $8\frac{1}{4}$. *Ans.* $13\frac{49}{80}$.

From 60 take $\frac{5}{7}$ of 60. *Ans.* $17\frac{1}{7}$.

From $\frac{60}{59}$ take $\frac{59}{60}$. *Ans.* $\frac{119}{3540}$.

If the fractions are of different denominations, find their simple values, and subtract one from the other.

Example.—From $\frac{9}{10}$ of a pound sterling take $\frac{7}{8}$ of a shilling.

	s.	d.
$\frac{9}{10}$ of 1*l.* =	18	0
$\frac{7}{8}$ of 1*s.* =	0	$10\frac{1}{2}$
Ans.	17	$1\frac{1}{2}$

From $\frac{5}{6}$ of a pound sterling take $\frac{2}{7}$ of $\frac{1}{5}$ of a pound.

Ans. 9*s.* $11\frac{3}{4}$*d.*+

From $\frac{5}{7}$ of a ton take $\frac{1}{2}$ of $\frac{3}{4}$ of a cwt.

Ans. 13 cwts. 3 qrs. 18 lbs.

From $41\frac{3}{5}$*l.* take $19\frac{9}{7}$*s.* *Ans.* 40*l.* 7*s.* $7\frac{1}{4}$*d.* and $\frac{3}{7}$.

From $\frac{7}{19}$ of 1 cwt. take $\frac{5}{7}$ of a quarter, and $\frac{2}{3}$ of 1 lb. avoirdupois. *Ans.* 20 lbs. 9 ozs. 9 drs. $\frac{1}{7}$.

Take $\frac{5}{7}$ of $\frac{2}{5}$ of 5*l.* from 100 half-crowns. *Ans.* 11*l.* 12*s.* $1\frac{3}{4}$*d.*

MULTIPLICATION.

RULE.—Reduce the mixed numbers to improper fractions, and compound fractions to simple ones; then multiply all the numerators together for a new numerator, and all the denominators together for a common denominator.

Example.—Multiply $4\frac{1}{5}$ by $\frac{2}{3}$ of $\frac{1}{8}$ of 6.

$4\frac{1}{5}=\frac{21}{5}$. $\frac{2}{3}$ of $\frac{1}{8}$ of $\frac{6}{1}=\frac{12}{24}$. $\frac{21}{5}\times\frac{12}{24}=\frac{252}{120}=2\frac{12}{120}$ *Ans.*

Multiply $\frac{5}{7}$ of $\frac{9}{11}$ by $8\frac{4}{5}$. *Ans.* $5\frac{55}{88}$.

Multiply $42\frac{3}{10}$ by $\frac{1}{2}$ of $\frac{5}{6}$ of 4. *Ans.* $70\frac{1}{2}$.

Multiply $15\frac{4}{7}$*l.* by $\frac{3}{5}$ of $4\frac{1}{2}$. *Ans.* $42\frac{3}{70}$.

Multiply $71\frac{15}{18}$ of 1 cwt. by $3\frac{1}{3}$. *Ans.* $278\frac{51}{140}$.

Multiply $2\frac{6}{17}$ of a ton by $\frac{4}{5}$ of $\frac{5}{6}$. *Ans.* $1\frac{51}{765}$.

How many yards are there in $24\frac{3}{8}$ pieces of cloth, each containing $10\frac{5}{19}$ yards? *Ans.* $250\frac{25}{152}$.

DIVISION.

RULE.—Reduce the fractions as in multiplication; invert the divisor, and proceed as in multiplication.

Example.—Divide $\frac{14}{15}$ by $\frac{3}{11}$. $\frac{14}{15}\div\frac{3}{11}$ inverted thus $\frac{14}{15}\times\frac{11}{3}=\frac{154}{45}$
$=$ *Ans.* $3\frac{19}{45}$.

Divide $8\frac{3}{5}$ by $\frac{1}{2}$ of $\frac{4}{5}$ of 5. *Ans.* $4\frac{3}{10}$.

Divide $\frac{1}{7}$ of $\frac{2}{3}$ of 18 by $\frac{5}{6}$ of $\frac{9}{10}$. *Ans.* $2\frac{600}{735}$.

Divide $18\frac{5}{8}$*l.* by $\frac{4}{10}$ of $\frac{3}{8}$. *Ans.* $124\frac{1}{6}$.

Divide $17\frac{9}{16}$ miles by $\frac{4}{9}$ of 3. *Ans.* $13\frac{1}{64}$.

Divide $1847\frac{3}{19}$ by 16. *Ans.* $115\frac{17}{38}$.

RULE OF THREE IN VULGAR FRACTIONS.

This rule in principle does not vary from the rule of Simple Proportion. But as fractions sometimes occur in the prices of articles which cannot be rejected in proportional calculations, a few illustrative exercises are subjoined.

RULE.—State the question as in Simple Proportion. Reduce the mixed numbers to simple fractions, multiply the second and third terms together, and divide by the first.

Example.—If $3\frac{1}{5}$ lbs. cost $8\frac{4}{7}$ shillings, what will $97\frac{3}{10}$ lbs. cost?

As $3\frac{1}{5}$: $97\frac{3}{10}$ :: $8\frac{4}{7}$: ———

Reduced thus: As $\frac{16}{5}$: $\frac{973}{10}$ :: $\frac{60}{7}$: 13*l.* $0\frac{10}{112}$*s. Ans.*

OR, invert the first term, and multiply all the numerators for a new numerator, and all the denominators for a new denominator, thus :—

$$\text{As } \frac{5}{16} : \frac{973}{10} :: \frac{60}{7} : \frac{291900}{1120} = 260\tfrac{17}{112}s. \text{ Ans.}$$

1. If $\frac{2}{9}$ of a yard of broad cloth cost 2*s.* 8*d.*, what will $14\frac{1}{2}$ yds. cost at the same rate? *Ans.* 8*l.* 14*s.*

2. If 1 anker of brandy cost $21\frac{5}{8}l.$, what will 1 hogshead cost? *Ans.* 136*l.* 4*s.* 9*d.*

3. A grocer purchased $5\frac{3}{5}$ puncheons of prunes for 514*l.*; what must be given for $25\frac{1}{4}$ at the same rate? 2414*l.* 12*s.* $1\frac{5}{4}\frac{}{3}d.$

4. If a mercer buy 19 pieces of silk, each $27\frac{4}{5}$ yards, at $3\frac{3}{5}s.$ per yard, what did the whole cost him? *Ans.* 96*l.* 16*s.* $8\frac{3}{4}d$

5. If $\frac{1}{2}\frac{4}{3}$ of an English ell cost $\frac{5}{3}$ of a shilling, what will be the amount of $39\frac{7}{8}$ yards? *Ans.* 4*l.* 7*s.* $4\frac{7}{8}d.$

6. Received for $\frac{9}{4}$ of a cwt. of lead $24\frac{3}{8}s.$, how much should $8\frac{3}{4}$ cwts. be charged? *Ans.* 4*l.* 10*s.* $8\frac{3}{4}d.$

7. How many lbs. of tobacco can be purchased for $15\frac{3}{6}l.$, at the rate of $28\frac{3}{4}s.$ per cwt.? *Ans.* 1207 lbs. 10 ozs. 6 drs.

8. A stationer bought $4\frac{1}{8}$ quires of foolscap paper at $4\frac{1}{2}d.$ per quire, what must be given for $15\frac{3}{4}$ reams? *Ans.* 5*l.* 18*s.* $1\frac{1}{2}d.$

9. Purchased by a merchant 1 bag of sugar at 2*l.* 0*s.* $0\frac{3}{4}d.$ per bag, what will be the amount of $278\frac{3}{7}$ bags at that rate?
Ans. 557*l.* 14*s.* $6\frac{1}{2}d.$ +

10. If 6 dozen lbs. of candles cost $3\frac{1}{7}l.$, what is that per lb.?
Ans. $10\frac{1}{4}d.$ +

DECIMAL FRACTIONS

Are so called because the fractions are always tenths, hundredths, thousandths, &c. They differ from Vulgar Fractions in this, that the denominator is not written; *instead of writing* $\frac{4}{10}$, *or* $\frac{15}{100}$, *the fraction would be written decimally,* ·4 *or* ·15. *The point before it is used to distinguish it from whole numbers.*

A decimal fraction is reduced to a vulgar fraction by placing a nought under each figure, and prefixing the number 1. Thus ·425 with 3 ciphers and 1 under it, would be $\frac{425}{1000}$, or four hundred and twenty-five thousandths.

Each cipher placed *before* a decimal decreases its value tenfold; thus ·4 is $\frac{4}{10}$, but ·04 is $\frac{4}{100}$, and ·004 is $\frac{4}{1000}$.

Ciphers placed after it do not alter its value; ·4 is equal to ·40 or ·400, because $\frac{4}{10}$ is equal to $\frac{40}{100}$ or $\frac{400}{1000}$.

ADDITION OF DECIMALS.

RULE.—Arrange the numbers to be added so that all the points are in a straight line. Add up as in simple numbers.

Add 3·15. 2·081. ·4085. 30·67. ·0084 together.
Ans. 36·3179.

Add 37. ·8. ·4075. 307·5. 5·862. 40·40. *Ans.* 391·9695.

Add 9·95. ·847. 375·375. ·0083. ·00001. ·415.
Ans. 386·63531.

Add 23. ·1817. 5·5. 84621. ·00010. 38·472. 3·816.
Ans. 84691·96980.

Add 189·432. 81·18. ·009. ·9841. 3. ·3. 7. ·7.
Ans. 282·6051.

SUBTRACTION OF DECIMALS.

RULE.—Arrange the numbers as in addition, and subtract as in simple numbers, taking care to insert the points.

From 41·308 take 4·72. *Ans.* 36·588.
From 7·084 take 2·847. *Ans.* 4·237.
From 81·5 take 41·082. *Ans.* 40·418.
From 365· take 3·650. *Ans.* 361·350.
From 425· take ·426 *Ans.* 424·574.
From 7·008 take ·0008. *Ans.* 7·0072.
From ·8764 take ·365. *Ans.* ·5114.
From 9·508 take ·1008. *Ans.* 9·4072.

MULTIPLICATION OF DECIMALS.

RULE.—Arrange the figures and multiply as in common multiplication. Count the number of decimals in both the multiplicand and multiplier, and point off so many figures at the right end of the product; if there be not figures enough in the product, place ciphers to the left, and put the point before them.

Example. Multiply ·24 by ·65

·24
·65

·1560 *Ans.*

Example. Multiply ·02 by ·045.

·02
·045
·00090

In this instance the product is only 90; but, as there are 5 decimals in the multiplicand and multiplier prefix 3 ciphers.

Multiply ·84 by ·84. *Ans.* ·7056.
Multiply 3·081 by 4·12. *Ans.* 12·69372.
Multiply 14·02 by 90·09. *Ans.* 1263·0618.
Multiply 1008· by ·1008. *Ans.* 101·6064.
Multiply 900 by ·009. *Ans.* 8·100.
Multiply 27·004 by 36·02. *Ans.* 972·68408.
Multiply 8·03 by ·008. *Ans.* ·06424.
*Multiply ·995 by 100. *Ans.* 99·500.
Multiply 3·07 by ·75. *Ans.* 2·3025.
Multiply 7·001 by ·001. *Ans.* ·007001.

DIVISION OF DECIMALS.

Rule.—Divide as in whole numbers. Mark off in the quotient as many decimal places as the dividend has more than the divisor.

If the divisor has more decimal places than the dividend, add ciphers to the right hand of the dividend.

When the divisor and dividend have an equal number of decimals, the quotient is a whole number.

The quotient must always have as many decimal places as the dividend has more than the divisor.

The first figure in the quotient is always of the same relative value as that figure which stands over its unit place in subtracting.

Example. Divide 2·5816 by 4·7.

4·7) 2·5816 (·549

In this case the decimals in the dividend exceed that in the divisor by 3, I therefore point off the 3 figures in the quotient as decimals.

Example. Divide ·804 by 18.

18) ·804 (·044

Here the decimals in the dividend exceed by 3 figures. The quotient has but 2 figures; I must, therefore, prefix a cipher to make the 3 decimals required.

* To multiply a decimal by 10, remove the point one figure more to the right; for 100, remove it two places.

Divide 4·84 by 1·35. *Ans.* 3·585. +
Divide ·382 by ·347. *Ans.* 1·10086. +
Divide 5·42 by 1·25. *Ans.* 4·336.
Divide ·75 by 8. *Ans.* ·09. +
Divide ·084 by 8. *Ans.* ·0105.
Divide 100· by ·001. *Ans.* 100000.
Divide 3·03 by 4·08. *Ans.* ·7426. −
Divide ·001 by 6. *Ans.* ·00016. −
Divide 1· by ·1. *Ans.* 10.

REDUCTION OF DECIMALS.

CASE 1.—*To reduce a decimal to a vulgar fraction.*

RULE.—Place a cipher under each decimal, and prefix a unit; thus, the vulgar fraction equal to the decimal ·584, is $\frac{584}{1000}$.

What vulgar fractions are equal to the decimals ·5, ·284, ·001, ·08437, ·00009, ·01, ·010 ?

CASE 2.—*To reduce a vulgar fraction to a decimal.*

RULE.—Divide the numerator by the denominator, add ciphers to any extent; the quotient is the decimal required.

Reduce $\frac{3}{5}$ to a decimal. *Ans.* ·6.
Reduce $\frac{9}{12}$ to a decimal. *Ans.* ·75.
Reduce $\frac{15}{16}$ to a decimal. *Ans.* ·9375.
Reduce $\frac{1}{425}$ to a decimal. *Ans.* ·0023529. +
Reduce $\frac{27}{400}$ to a decimal. *Ans.* ·0675.
Reduce $\frac{1}{1000}$ to a decimal. *Ans.* ·001.

CASE 3.—*To reduce money, weights, or measures, to equivalent decimals.*

RULE.—Divide by as many of the lower denominations as make one of the higher, annexing ciphers at will. If there be several denominations, proceed in the same manner with each, beginning with the lowest denomination.

Example.—Reduce 12*s.* 8¼*d.* to the decimal of a pound sterling.

4)1.

12)8·25 the decimal 25 = ¼.

20)12·6875 the decimal 6875 = 8¼*d.*

·634375 the decimal of 12*s.* 8¼*d.*

Reduce 17*s.* to the decimal of 1*l.* *Ans.* ·85.
Reduce 11*s.* 10½*d.* to the decimal of 1*l.* *Ans.* ·59375.
Reduce 15*s.* 9¾*d.* to the decimal of 1*l.* *Ans.* ·790625.
Reduce 5 cwts. 2 qrs. 10 lbs. to the decimal of a ton.
Ans. ·2794. +
Reduce 3 lbs. 5 ozs. to the decimal of a cwt. *Ans.* ·02957. +
Reduce 12 dwts. 10 grs. to the decimal of 1 lb. troy.
Ans. ·05173. +
Reduce 3 ft. 8 in. to the decimal of a yard. *Ans.* 1·22. +
Reduce 45 days to the decimal of a year. *Ans.* ·1232. +
Reduce 3 fur. 4 po. to the decimal of a mile. *Ans.* ·3875
Reduce 3 qrs. 3 nails to the decimal of an English ell. *Ans.* ·75

CASE 4.—*To find the value of any decimal.*

RULE.—Multiply the decimal by the number of the next lower denomination which is equal to one of its present denomination. Cut off as many places for decimals as the multiplicand has.

Example. What is the value of ·815*l.*?

·815
20

16·300
12

3·600
4

2·400 *Ans.* 16*s.* 3½*d.* ⅖.

What is the value of ·525*l.*? *Ans.* 10*s.* 6*d.*
What is the value of ·08*l.*? *Ans.* 1*s.* 7*d.* +
What is the value of ·0095*l.*? *Ans.* 2¼*d.*
What is the value of ·8475*l.*? *Ans.* 16*s.* 11¼*d.*
What is the value of ·425 of a cwt.? *Ans.* 1 qr. 19 lbs. 9 ozs. 9 drs.
What is the value of ·375 of a ton? *Ans.* 7 cwts. 2 qrs.
What is the value of ·7865 of a mile?
Ans. 6 fur. 11 po. 3 yds. 2 ft. 2 in. 1 bar.
What is the value of ·3 of a cwt.? *Ans.* 1 qr. 5 lbs. 9 ozs. 9 drs.
What is the value of ·008 of a mile?
Ans. 2 po. 3 yds. 0 ft. 2 in. 2 bar.
What is the value of ·625 of a year? *Ans.* 7 mo. 15 days
What is the value of ·251 of an acre? *Ans.* 1 rd. 4 yds. 7 ft.

RULE OF THREE IN DECIMALS.

This rule is useful when the price of articles which stand in relative proportion have their fractional parts expressed decimally.

RULE.—State the question as in Simple Proportion. Reduce the first and second terms to decimals of the same name. Multiply the second and third terms together, and divide by the first term.

Example.—If 2·625 tons cost 36·75*l.*, what is the value of 1·5 lb.?

	tons.	lbs.	£	
	As 2·625	: 1·5	: : 36·75	: ————
	lbs.	lbs.	£	d. d.
Reduced thus :	As 5880	: 1·5	: : 36·75	: 2·25, or 2¼ *Ans.*

1. How many lbs. of tea can I buy for 30*l.*, when 2 lbs. cost 11·125*s.*? *Ans.* 107·865 lbs.+

2. If 2·825 qrs. of coffee cost 9·875*l.*, what is the value of 1 cwt.? *Ans.* 13·98*l.*+

3. How much sugar, at 4 guineas per cwt., can I buy for 3·16*l.*? *Ans.* 84·26 lbs.

4. If 6·5 ounces of fine silver be sold for 1·95*l.*, what must be given for 3·75 lbs. at the same rate? *Ans.* 13·5*l.*

5. Bought 3·125 qrs. of cheese for 11·65*l.*, at what rate was that per cwt.? *Ans.* 14·912*l.*

6. How many ankers of brandy may be purchased for 3967·15*l.* at 2·5*s.* per pint? *Ans.* 396·7*a.*+

7. If 9 lbs. of lead cost 11·5*d.*, what will 3 fothers, each 19·5 cwt. come to? *Ans.* 34·88*l.*+

8. If 3 bushels of wheat cost 1·1*l.* what will 33·4 qrs. come to at the same rate? *Ans.* 97·97*l.*+

9. Bought 8 lbs. of tobacco for 18·18*s.*, at what rate was that per cwt.? *Ans.* 12·7*l.*+

10. If 5 men earn 38·525*l.* in 3 weeks, what will 18 men earn in the same time? *Ans.* 138·69*l.*

11. If for 4 weeks' wages I receive 5·825*l.*, what is my yearly salary? *Ans.* 75·725*l*

12. What must my income be that I may be able to spend daily 15*s.* 6*d.*, and lay by at the year's end 123·55*l.*? *Ans.* 406·425*l.*

13. A. is indebted to B. 913·35*l.*, and agrees to pay him 13·5*s.* in the pound. I demand how much B. will receive of him? *Ans.* 616·5*l*

This rule teaches how to find the number of feet in anything, either solid or superficial, and to charge for it accordingly.

To find the superficial contents multiply the length by the breadth; for a solid cube, or a parallelopipedon, multiply the length by the breadth, and that product by the depth.

The area of a figure is the space within the bounds of the surface. Thus, the area of a circle is the space contained within the circumference.

GLAZING AND MASONS' FLAT WORK.

This is measured and charged by the square foot.

1. What is the worth of 16 squares of glass-work, each measuring 4 ft. 10 in. long and 2 feet 11 in. broad, at 1*s.* 6*d.* per foot? *Ans.* 16*l.* 18*s.* 4*d.*

Here the content is found by Duodecimals, and the value by Practice; the worth of 6 in. 8 sec. is found by itself, and added to it.

2. What will a piece of glass, that is 7 ft. 4 in. long and 5 ft. 6 in. broad, come to at 6*s.* per foot? *Ans.* 12*l.* 2*s.*

3. A house having 24 windows, each measuring 1 ft. 6 in. 3″ wide and 3 ft. high, how much will they come to at 2*s.* 4*d.* per foot? *Ans.* 12*l.* 15*s.* 6*d.*

4. There is a house with 4 tiers of windows. The height of the first 7 ft. 6 in., the second 6 ft. 8 in., the third 5 ft. 11 in., the fourth 5 ft. 2 in.; the breadth of each 4 ft. 10 in. What will it cost to glaze them at 3*s.* 4*d.* per foot? *Ans.* 20*l.* 6*s.* 9½*d.*

5. What is the price of a grave-stone, the length being 6 ft. 6 in. and the breadth 3 ft. 3 in., at 4*s.* 6*d.* per foot? *Ans.* 4*l.* 15*s.* 0¾*d.*

6. What is the value of a marble slab, whose length is 11 ft. 2 in. and breadth 3 ft. 8 in., at 2*l.* per foot? *Ans.* 81*l.* 17*s.* 9¼*d.*

7. What will it cost to pave a kitchen, which measures 12 ft. 6 in. by 10 ft. 4 in., at 12*s.* 6*d.* per foot? *Ans.* 80*l.* 14*s.* 7*d.*

Solid Measure.

1. What is the value of a block of marble 12 feet long, 10 feet broad, and 7 feet thick, at 14*s.* per solid foot? *Ans.* 588*l.*

2. How many 3-inch cubes could be cut out of the above, and what would be the value of each? *Ans.* 53760 cubes, 2½*d.* each.

3. A builder buys a stack of timber, which measures regularly 98 ft. 8 in. long, 5 ft. 4 in. wide, and 3 feet thick. What is it worth at 2*s.* 8*d.* per foot solid? *Ans.* 210*l.* 9*s.* 9¼*d.*

4. How many solid feet in a thick slab 12 feet long, 9 feet broad and 6 inches thick? *Ans.* 54.

PAINTING, PLASTERING, JOINING, &c.

Measuring by the Square Yard.

Note.—Divide the square foot by 9, and it will give the square yard.

1. What should a painter charge for painting a room, the walls of which were 8 feet high, the room 18 ft. by 14, ceiling included, at 2*s.* 8*d.* per yard? *Ans.* 11*l.* 6*s.* 4½*d.*

2. What should be charged for painting 3 rooms, the first 15 feet by 12, walls 7 feet high; the second 13 feet by 9, walls 6 ft. 9 in. high; the third 20 feet by 15, walls 8½ feet high; at 1*s.* 3*d* per yard? *Ans.* 8*l.* 16*s.* 4¼*d.*

3. What should be charged for painting on each side 10 doors, whose measure is 6 ft. 6 in. high, 3 ft. 8 in. broad, at 7½*d.* per yard? *Ans.* 1*l.* 13*s.* 0½*d.*

4. What should be charged for painting the outside and inside of a large box 7 ft. 4 in. long, 4 ft. 8 in. wide, and 3 ft. 10 in. deep, at 8½*d.* per yard? *Ans.* 1*l.* 5*s.* 3*d.*

5. What will a piece of wainscoting come to at 6*s.* 7½*d.* per yard, which measures 8 ft. 3 in. by 6 ft. 6 in.? *Ans.* 1*l.* 19*s.* 5*d.*

FLOORING, PARTITIONING, ROOFING, TILING, &c.

Or Measuring by the Square of 100 feet.

These are measured by squares of 10 feet, each square containing 100 feet, that is by 100; therefore, divide the feet in the product by 100, and it will give the number of squares.

1. How many squares are there in a partition measuring 361 ft. 6 in. long, and 26 ft. 6 in. high, and what will it come to at 4*l.* 10*s.* per square? *Ans.* 95 squares, 79 ft. 9 in.—431*l.* 1*s.* 9¼*d.*

2. If a house measures within the walls 26 ft. 4 in. long, and 15 ft. 3 in. broad, and the roof be of a true pitch,* what will it come to roofing at one guinea per square? *Ans.* 6*l.* 6*s.* 5¼*d*

3. What shall a workman receive for roofing a house that measures 70 ft. in depth and 40 ft. in width, at 10*s.* 8*d.* per square? *Ans.* 22*l.* 8*s.*

4. What will the tiling of a barn come to at 12*s.* 9*d.* per square, the length being 43 ft. 10 in. and breadth 27 ft. 6 in. on the flat, the eave-boards projecting 16 in. on each side? *Ans.* 12*l.* 5*s.* 5¼*d.*

* The roof is of a true pitch when the rafters in length are ⅝ths of the breadth of the building, it is then customary to take the flat and half the flat within the walls as the measure of the roof: when it is not of a true pitch it is measured by rod or string.

BRICKLAYERS' WORK,

Or Measuring by the Rod.

Bricklayers always value their work at a brick and a half, or three half bricks, thick, which is called standard measure.

Rule.—Multiply the total number of feet in the wall by the number of half bricks in the thickness of it, and divide the product by 3, which will give the standard measure; then divide by $272\frac{1}{4}$ (the square of $16\frac{1}{2}$ feet), and the quotient will be the rods required.—The $\frac{1}{4}$ is mostly rejected, in favour of the workmen.

Example.

1. If a wall be 1000 feet long, and 6 feet high, and $2\frac{1}{2}$ bricks thick, how many rods does it contain, and what will it come to at 2*l.* 15*s.* per rod?

1000 length	2	15	0	cost of 1 rod.
6 feet high			36	
6000	99	0	0	of 36 rods.
5	2	8	$1\frac{1}{2}$	$= \frac{7}{8}$ of 2*l.* 15*s.*
3)30000	101	8	$1\frac{1}{2}$	

272)10000 standard $36\frac{13}{17}$ rod, *Ans.*

1. A wall measuring 782 feet in length, 9 feet high, $3\frac{1}{2}$ bricks thick, how much will it come to at 3*l.* 12*s.* per rod? *Ans.* 217*l.* 7*s.*

2. How many rods are contained in a schoolroom 25 ft. long, 10 ft. high, 15 ft. broad, and the gable* of which at the end measures 9 ft. 6 in. in height, $1\frac{1}{2}$ brick thick? and what does it come to at 3 guineas per rod? *Ans.* 10*l.* 18*s.* 3*d.*

An Exercise on all the Trades.

A new house being finished, the tradesman brought in the following accounts:—The bricklayer's was 22,440 standard ft., at 3*l.* 18*s.* per rod; the roof 2250 ft., at 3*l.* 10*s.* per sq. of 100 ft.; the plastering 1683 ft., at 4*s.* per yd. The carpenter's, 9864 ft. at 6*d.* per foot, and 925 ft. of flooring at 6*l.* 15*s.* per square of 100 feet. The painter's, 9810 ft. at $5\frac{1}{2}$*d.* per yard. The pavior's 621 ft. at 3*s.* 2*d.* per yd. The plumber's, 3 cwts. 2 qrs. 21 lbs. of lead at 3*l.* 10*s.* per cwt. The glazier's, 724 ft. of glass at 2*s.* 6*d.* per ft. What was the total cost of the house? *Ans.* 885*l.* 19*s.* $0\frac{1}{2}$*d.*

* To find the number of feet in the gable, or triangular part, you must multiply the breadth at bottom by half the height.

EXTRACTION OF THE SQUARE ROOT.

TO EXTRACT THE SQUARE ROOT IS TO FIND A NUMBER WHICH MULTIPLIED BY ITSELF WILL PRODUCE THE GIVEN NUMBER.

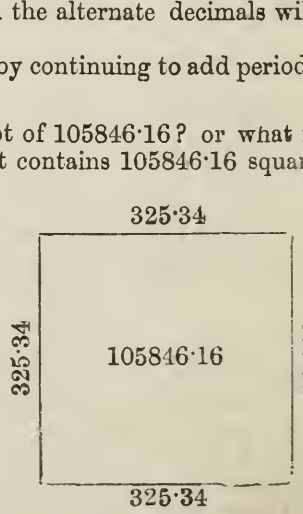
RULE.—Mark a point over the unit figure, and over every alternate figure, which will divide the line into periods of two figures each. Place the root whose square most nearly approximates to the first period, in the quotient. Subtract the square of it from the first period. Bring down the next period to the remainder for a fresh dividend. Double the figure in the quotient for a divisor, and find how many times it is contained in the *tens* of the dividend. Place the figure representing the number of times in the quotient, and also as the unit figure in the divisor. Multiply the divisor by the last figure in the quotient. Subtract the product; bring down another period, and proceed thus till the whole are brought down. The quotient is the root required.

Note.—If there be decimals, the first point is still to be on the unit figure of the *whole* numbers, and the alternate decimals will be marked from it.

The value of a remainder is found by continuing to add periods of noughts.

Example.—What is the square root of 105846·16? or what is the length of a side of a square if it contains 105846·16 square inches on its surface?

```
  . .  .  .
105846·16(325·34 Ans.
 9
---
62)158
   124
---
645)3446
    3225
-----
6503)22116
     19509
     -----
65064)260700
      260256
```



What is the square root of 9025? *Ans.* 95.
What is the square root of 177241? *Ans.* 421.
What is the square root of 197136? *Ans.* 444.

What is the square root of 2052·09? *Ans.* 45·3.
What is the square root of 1? *Ans.* 1.
What is the square root of 47585·0596? *Ans.* 218·14.
What is the square root of 8116·2081? *Ans.* 90·09.
What is the square root of ·5625? *Ans.* ·75.
What is the square root of ·0064? *Ans.* ·08.

The square root of a vulgar fraction is found by extracting the square root of the numerator for a new numerator, and the square root of the denominator for a new denominator.

What is the square root of $\frac{16}{25}$? *Ans.* $\frac{4}{5}$.
What is the square root of $\frac{625}{11881}$? *Ans.* $\frac{25}{109}$.
What is the square root of $\frac{121}{289}$? *Ans.* $\frac{11}{17}$.
What is the square root of $\frac{169}{441}$? *Ans.* $\frac{13}{21}$.

To extract the square root of a mixed number, reduce it to an improper fraction, and proceed as in the last case.

What is the square root of $6\frac{9}{25}$? *Ans.* $2\frac{2}{5}$.
What is the square root of $29\frac{52}{81}$? *Ans.* $5\frac{4}{9}$.
What is the square root of $19\frac{1021}{1121}$? *Ans.* $4\frac{5}{11}$.
What is the square root of $104\frac{1}{25}$? *Ans.* $10\frac{1}{5}$.
What is the square root of $469\frac{4}{9}$? *Ans.* $21\frac{2}{3}$.

If the vulgar fraction whose root is sought be a surd, that is, a number of which the root cannot be exactly found, reduce the vulgar fraction to a decimal, and extract the required root.

What is the square root of $\frac{49}{60}$? *Ans.* ·9036. +
What is the square root of $14\frac{5}{6}$? *Ans.* 3·851. +

EXTRACTION OF THE CUBE ROOT.

To extract the Cube Root is to find a number which, when cubed, is equal to the given number.

Rule.—Mark a point over every third figure, beginning at the unit figure. Place the root of the first period in the quotient, and its cube under the first period. Subtract, and to the remainder bring down the next period of three figures. Multiply the square of the quotient by 300 for a divisor. Find how often it is contained in the dividend, and put the number in the quotient. Multiply the divisor by this number. Add to the product the amount of all the figures in the quotient, multiplied by 30, except the last, and that product by the square of the last. To this add

the cube of the last figure in the quotient, and subtract the whole from the dividend. Bring down another period, and proceed as before described.

Example.—What is the cube root of 15625? or, what is the number of square inches on each side of a cube which contains 15625 cubic inches?

```
                . .
15625(25          Proof.
 8          25 × 25 × 25 = 15625.
----
2 × 2 × 300 = 1200)7625 resolvend.
                   ----
                   6000 = divisor × 5
                   1500 = 2 × 30 × 25
                    125 = cube of 5
                   ----
                   7625 subtrahend.
```

What is the cube root of 357911? *Ans.* 71.
9938375? *Ans.* 215.
125000000? *Ans.* 500.
1273760704? *Ans.* 1084.
91·125? *Ans.* 4·5.
1749·690125? *Ans.* 12·05.
1040433·022637? *Ans.* 101·33.

The cube root of a vulgar fraction is found by extracting the cube root of the numerator for a new numerator, and the cube root of the denominator for a new denominator.

What is the cube root of $\frac{1}{125}$? *Ans.* $\frac{1}{5}$.
What is the cube root of $\frac{64}{125}$? *Ans.* $\frac{4}{5}$.
What is the cube root of $\frac{27}{1331}$? *Ans.* $\frac{3}{11}$.
What is the cube root of $\frac{512}{3375}$? *Ans.* $\frac{8}{15}$.

To extract the cube root of a mixed number, reduce it to an improper fraction, and proceed as in the last case.

What is the cube root of $37\frac{1}{27}$? *Ans.* $3\frac{1}{3}$.
What is the cube root of $319\frac{17}{216}$? *Ans.* $6\frac{5}{6}$.
What is the cube root of $6\frac{859}{1000}$? *Ans.* $1\frac{9}{10}$.
What is the cube root of $1953\frac{1}{8}$? *Ans.* $12\frac{1}{2}$.

If the fraction be a surd, reduce it to a decimal, and then extract the root.

What is the cube root of $\frac{6}{7}$? *Ans.* ·949. +
What is the cube root of $7\frac{3}{7}$? *Ans.* 1·966. +

MISCELLANEOUS QUESTIONS

In the foregoing Rules.

1. King Solomon's annual revenue was 666 talents of gold, each weighing $114\frac{1}{16}$ lbs. troy; what was that in pounds sterling, the Mint price being 3*l.* 17*s.* $10\frac{1}{2}$*d.* per oz.?

2. What does the pay of a man of war's crew of 640 men amount to for 32 months' service, at 22*s.* 6*d.* per month for each man?

3. The less of two numbers is 187, and their difference 34, what is the square of their product?

4. A tenant was behind with his landlord for $16\frac{3}{4}$ years' rent, at 5*l.* 10*s.* a year, what was the debt?

5. In 47,128 nails of Irish cloth how many pieces, each 12 yds.?

6. How many seconds since the birth of Christ to Christmas, 1833?

7. Coals at 66*s.* per chald. of 36 bu. how much per bushel?

8. At 13*s.* 4*d.* per week how many months' board for 100*l.*?

9. What is the interest of 152*l.* for 2 years, at $2\frac{1}{2}$ per cent. per annum?

10. Bought 19 fother of lead at 14*s.* per cwt.; what is gained by its being sold at 4*d.* per pound?

11. A draper bought 100 yards of cloth for 56*l.*, how much must he sell it at per yard to gain 15*l.* in laying out 100*l.*?

12. A field contained 7 acres, another 10, a third 12 acres 1 rood; how many shares, of 76 perches each, are contained in the whole?

13. A church was built in 8 months by 120 workmen: being burnt, how many workmen would rebuild it in two months?

14. There being 4 bags of money, containing 34*l.*, 50*l.*, 100*l.*, and 150*l.*; one of these bags being lost, only 234*l.* were paid; which bag was lost?

15. How long would it take to count the national debt of 800,000,000 sovereigns, allowing a second for each?

16. A. bought 100 yds. of lace at 3 yds. for a 1*s.*, and 100 2 yds. for a shilling; sold at the rate of 5 yds. for 2*s.*, what was the loss?

17. What is the amount of 1000*l.* for $5\frac{1}{2}$ years at $4\frac{3}{4}$ per cent simple interest?

18. Bought a cask of wine for 62*l.* 8*s.*, how many gallons of wine did it contain, the price being 10*s.* 8*d.* per gallon?

19. From 14 cheeses weighing 3 qrs. 2½ lbs. each, how many slices can be cut of 5 ozs. 7 drams each?

20. In 9 casks of oil weighing 417 cwts. 1 qr. 15 lbs., tare 20 lbs. per cwt., how many gallons of 9 lbs. net?

21. Gave a hhd. of gin, at 7*s.* 4*d.* per gallon, for 56 gallons of rum; what is the rum worth per gallon?

22. A bankrupt's effects paid 7*s.* 9*d.* per pound, his debts amounting to 14,980*l.*; what did his creditors receive and lose?

23. Sold 21 yards of silk at 15*s.* 6*d.*, and 3 yards at 14*s.* 10*d.*, allowing 5 per cent. discount for cash; what was received?

24. A tradesman failed for 10,000*l.*, his effects produced 6798*l.* 10*s.*, what did a creditor receive whose debt was 790*l.* 18*s.*?

25. Of what principal did 20*l.* interest arise in 1 year, at 5 per cent.?

26. Divide 1000*l.* among 3 persons; give A. 120*l.* more, and B. 95*l.* less than C.

27. A debtor paid 1643*l.* 15*s.* for 1250*l.* held for 7 years, what was the rate of interest?

28. Bought goods value 420*l.* at six months' credit; paid down 120*l.*; when should the balance be settled?

29. To what number can you add $7\frac{2}{3}$ that the sum will be $12\frac{1}{4}$?

30. From what numbers can you subtract $\frac{3}{5}$ that the remainder will be $\frac{1}{5}$?

31. What number multiplied by $\frac{3}{7}$ will produce $11\frac{9}{17}$?

32. What number divided by $\frac{3}{4}$ will give as quotient 21?

33. Required a number from which if you take $\frac{2}{3}$ of $\frac{4}{5}$ of itself, the remainder will be equal to $\frac{1}{12}$ of $\frac{9}{10}$ of 560?

34. If $\frac{2}{3}$ of an ounce cost $\frac{7}{8}$ of a shilling, what will $\frac{5}{6}$ of 1 lb. cost?

35. If $\frac{5}{6}$ of a gallon cost $\frac{5}{8}$ of a pound, what will $\frac{5}{9}$ of 1 tun cost?

36. If the breadth of a board be 8 inches, how many feet will be wanted for a door 4 feet by $6\frac{1}{2}$?

37. A French franc is worth 10*d.*, how many in 100*l.*?

38. Two persons start for York on the same day; one walks 19 miles a day, the other $15\frac{1}{2}$ miles; how far distant will they be after ten days' travelling, and when will each get to York—200 miles?

Ans. Distance 35 miles; the first gets to York on the 11th day, the other on the 13th.

39. The population of the world is 1000 millions. If the earth be re-peopled every $33\frac{1}{3}$ years, how many persons are born and die in a day?

40. A balloon moving at the rate of 6492 feet in a minute, how long would it be in sailing round the earth?

41. Three persons purchased a ship; A. pays for $\frac{2}{5}$, B. for $\frac{3}{8}$, and C. pays 2700*l.* for the remainder; what is the value of the ship?

42. A. has 150 cwts. of tobacco, at 3*s.* $10\frac{1}{2}$*d.* per lb., for which B. gives him 10*l.* 17*s.* 6*d.*, and cloth at 11*d.* per yard; required the quantity of cloth to complete the barter?

43. Bought 10 casks of sugar, each weighing 7 cwts. 3 qrs. 10 lbs. at 2*l.* 10*s.* per cwt., at what must it be sold per lb. to gain 10*l.* by the bargain?

44. Bought 420 yards of cloth at 3*s.* 2*d.* per yard, and sold it at 3*s.* 10*d.* per yard; what is the gain on the whole quantity, and what the gain per cent.?

45. A dealer sold hams at $6\frac{1}{2}$*d.* per lb. which cost him $7\frac{1}{4}$*d.* per lb.; what did he lose per cent.?

46. If I buy at 16*s.* per cwt., and sell at a guinea, what do I gain per cent.?

47. Three travellers met where there were no provisions; the first brought 5 loaves, the second 3 loaves, the third paid 8*d.*; how should this money be shared between the two.?

Ans. One 7*d.*, the other 1*d.*

48. If a tobacconist barter with a tallow-chandler for 100 dozen of candles which for ready money are 6*s.* per dozen, but in barter 6*s.* 6*d.*, how much tobacco must he give for them when the ready money price of tobacco is 4*s.* per lb.?

49. Europe is supposed to contain 227,700,000 inhabitants; how much would $\frac{1}{2}$*d.* per head per month amount to in 7 years?

50. If a stick standing perpendicularly 3 feet above the ground project a shadow of 2 ft. 8 in., what must be the height of a tower whose shadow measures 74 feet?

51. A country containing half a million of persons, was taxed at the rate of 3*s.* 4*d.* per head; required the amount of the tax in half-crowns?

52. If 64 yards of carpet at 3 qrs. wide cover a floor, how much cloth of 5 qrs. wide would do it?

53. The city of Rome contains 100,000 inhabitants; what tax must be levied upon each to produce 2916*l.* 13*s.* 4*d.*?

54. If a bankrupt's estate pay 7*s.* 9*d.* in the pound, what is lost on a debt of 123*l.* 15*s.*?

55. If 3 cows can be kept on 20 acres 3 roods, how much will 25 cows require?

56. The distance of the moon is 240,000 miles; how much nearer to us is it than the sun, which is 95,000,000 of miles distant?

57. If the fourth of 20 be 8, what will be the half of 100?

58. Bought 200 eggs at 2 a penny, and 200 at 3 a penny; sold the whole at 5 a penny, what was gained or lost by the whole?

59. What is the value of ·625 of a pound, ·34 of a shilling, and ·95 of a penny?

60. A company spent 20*l.*; at rising each man had to pay as many shillings as there were persons in company, what was the number?

61. What is the interest of 51·425*l.* at 4·125 per cent.?

62. From $2\frac{3}{16}$ of a pound, $4\frac{5}{8}$ of a shilling, and $\frac{2}{3}$ of a penny, subtract $\frac{4}{5}$ of $\frac{5}{6}$ of a sovereign.

63. The toll-keeper at Southwark Bridge received in one day 18*l.* 14*s.* 6*d.*; coaches paid 1*s.* each, chaises 4*d.* each, ridden horses 2*d.* each, and foot passengers 1*d.* each, and for every coach there passed 4 chaises, 3 horses, and 8 passengers; how many of each?

64. What is the sum, difference, and product of 4 ft. 6 in. and 2 ft. 8 in., the result to be obtained by Vulgar Fractions, Decimals, and Duodecimals?

		ft.	in.	
Ans.	Sum	7	2	duodecimally,
		$7\frac{1}{9}$		fractionally,
		7·166		decimally. +
	Difference	1	10	duodecimally,
		$1\frac{5}{6}$		fractionally,
		1·833		decimally. +

Product 12 feet.

65. Light travels from the sun at the rate of 192,268 miles in a second; how long is it coming to us from that luminary?

Ans. 8 min. 14 sec.

66. Sound proceeds at the rate of 1142 feet in a second. If, after a cannon is fired, $3\frac{3}{4}$ minutes elapse before the report is heard, what is the distance?

67. The pressure of the atmosphere on every square inch of surface is equal to 15 lbs.; what is the pressure upon the superficies of the human body, which is equal to 14 square feet; and what is the pressure upon the whole of the earth's surface, calculated at 200,000,000 square miles?

68. How long would a fly be in walking round the globe, supposing he travelled at the rate of three inches per second, the distance being about 25,020 miles?

69. The "*Arithmeticon*" will produce 25,000,000,000 of sums: allowing a minute for the working of each, how long would a person be in performing them; and what length would they take up, allowing an inch for every sum?

Ans. 47,532 yrs. 4 da. 19 hrs. 28 min time; and 394,570 mi. 0 fur. 22 po. 3 yds. 1 ft. 4 in. length.

70. If the skin of the human body contain 2,016,000,000 of pores; what would be the number in all the inhabitants of the globe, reckoned at 768,000,000?

71. The surface of the earth contains 148,522,000 square miles; if 111,092,000 miles are covered with water, how many acres of land remain?

72. Europe contains 2,793,000 square miles; how many inhabitants would it support, if $3\frac{1}{2}$ acres supported a family of five on an average?

73. The revenue of France was 39,560,000*l.*, and its debt 184,960,000*l.*; how much of the former did it take to pay interest on the latter at $3\frac{1}{2}$ per cent.?

74. The surface of China is 4,070,000 square miles; how much land would each individual of the population, estimated at 170,000,000, have for his share, if equally divided?

75. From 1817 to 1827 there were 37,855,633 sovereigns coined, each weighing 5 dwts. $3\frac{1}{4}$ grs.; how many bars of gold of 12 lbs. each would they form if remelted?

76. In the same period 462,476 crowns, 4,148,694 shillings were coined. If the crown be estimated to weigh 18 dwts. 4 grs., the shilling 3 dwts. 15 grs., what number of ingots of 18 lbs. 6 ozs. 8 dwts. did it take for their production?

ABBREVIATED MULTIPLICATION.

It is necessary to the full comprehension of the Science of Arithmetic that it be taught on general principles, which apply to all cases; but the practised arithmetician often finds shorter methods of obtaining particular results; and, as the end of arithmetic is despatch, they deserve attention. Some of these are very obvious; as, for instance, the following in multiplying by two numbers, when one of them is a unit:—Instead of multiplying by both figures, multiply only by the number above unity; and place the product one figure to the right or left, according as the unit is before or after.

Example 1.—Multiply 4108 by 15.

4108 = 10 times 4108
20540 = 5 times 4108

61620 = 15 times 4108

Example 2.—Multiply 4108 by 51.

4108
20540 = 50 times 4108

209508 = 51 times 4108

Multiply 2004 by 13.	Multiply 2004 by 31.
—— 5814 by 14.	—— 5814 by 41.
—— 555 by 16.	—— 555 by 61.
—— 2847 by 19.	—— 2847 by 91.

In multiplying by 25, add two noughts, which are equivalent to multiplying by 100, and divide by 4.

Example.—Multiply 2452 by 25.

4)245200

61300

Multiply by 25.....4137	2817
—— 5842	515
—— 3786	84

TO BRING TONS, CWTS., QRS., AND LBS. INTO LBS., IN ONE LINE.

Example.— Bring 12 tons 15 cwts. 3 qrs. 15 lbs. into pounds.

cwt.	qrs.	lbs.
255	3	15
112		
	99	
28659		

As 20 cwts. make 1 ton, 12 tons 15 cwts. are seen at a glance to be 255 cwt. The operation then is to multiply by 12, add the figure last multiplied and 99, the number of pounds in 3 qr. 15 lb.

OR

Put down 255; double it above, with one figure to the right; repeat it below, with one figure to the left; and add the 99 lbs., as before.

510
255
255
99
28659

	tons.	cwt.	qrs.	lbs.	
In	0	5	2	10	how many pounds?
—	0	14	1	8	how many pounds?
—	0	17	3	12	how many pounds?
—	0	15	3	17	how many pounds?
—	5	13	2	19	how many pounds?
—	11	14	1	17	how many pounds?
—	8	11	3	5	how many pounds?
—	12	12	2	13	how many pounds?

If the question contains only tons and cwts., the following is as expeditious as either of the preceding methods:

Multiply the number of cwts. by the 12, and place the product two figures to the right of the multiplicand.

Example.—Bring 14 tons 15 cwts. into pounds.

cwt.
295 = 100 times 295
3540 = 12 times 295

Ans. 33040 = 112 times 295

MENTAL ARITHMETIC.

INTRODUCTION.

MENTAL ARITHMETIC possesses so great a superiority in common calculations, and presents so many advantages to persons engaged in business, especially in ready-money trades, that instead of forming NO PART of common education, it ought to form its most prominent feature. Its importance is second only to Scriptural instruction, not only from its usefulness as an acquirement, but from its tendency to draw forth the faculties of the mind, and to fix and concentrate them on particular objects; it is the mind's powers exercised in this way that makes the acute thinker and solid reasoner.

Until the present attempt, the numerous peculiarities regarding the relations of numbers, the various short methods of reducing, extending, or separating quantities by a purely mental process, had never been brought into a system. In this series of mental instruction, the object has been to systematize, and to lead the mind by *imperceptible gradations* to the highest results; to form, in fact, a continuous chain, regularly linked and interwoven, from the lowest to the highest extremity; for this purpose it commences with very simple questions, and rises gradually to those apparently the most intricate, extending through all numerical relations, weights, measures, fractions, and proportions, from simple unity to the complicated involutions of compound numbers, *rejecting all arithmetical trifling*, and subjecting every rule to the *test of utility*.

The teacher will understand that it is not intended for the pupil to pass through the preceding rules before he enters upon mental calculations; although this portion of the work is placed last, it should be made use of as soon as a child can be brought to understand the simplest parts of common arithmetic; and, in doing so, he must not suffer the connection of one part of the system ever to be broken, but proceed steadily and uniformly through the whole series, bearing in mind the maxim of Lord Bacon, "Knowledge can only be based on knowledge previously acquired."

MENTAL ARITHMETIC.

The questions in this introductory lesson are for the most part suited to very young minds, and if illustrated by 30 pebbles, marbles, or peas, or by dots or lines on a slate, there are none which will not be readily comprehended by any child of six years of age. Yet experience has shown that this foundation is all that is necessary to base a knowledge of mental arithmetic, which excites astonishment in every one who witnesses it.

The pupil should not be urged to answer hastily, but should be allowed time to see clearly each combination before he is allowed to proceed; for although the order in which the questions are arranged may not at a first glance appear to be natural, yet it is that order which a patient and observant experience has shown to be the best.

This exercise has been found sufficient; if, however, the teacher require it, he may vary the questions by substituting any other two numbers instead of 5 and 6, as 4 and 5, in which he will require only 20, or 6 and 8, &c.

It is highly desirable that the pupil be not allowed to pass it too soon; for independently of its preparing the mind for that peculiar abstraction essential to mental calculation, it renders familiar many of the general principles and much of the subsequent operations of arithmetic.

ADDITION.—5 nuts and 6 nuts? 2 fives? 3 fives? 4 fives? 5 fives? 2 sixes? 3 sixes? 4 sixes? 5 sixes? 6 sixes?

SUBTRACTION.—Take 5 apples from 30? 5 from 25? 5 from 20? 5 from 15? 5 from 10? Take 6 from 36? 6 from 30? 6 from 24? 6 from 18? 6 from 12?

MULTIPLICATION.—5 times 5, or how many plums in 5 parcels of 5 plums in each parcel? 5 times 6? 6 times 5?

DIVISION.—How many fives in 30, or 30 nuts among 5 boys how many to each? 5 in 25? 5 in 20? 5 in 15? 5 in 10?

What is one-half of 30? One-third of 30? One-fifth? One-sixth? One-tenth? Or one-fifteenth?

Note.—See Table on the Frontispiece for an illustration of ½, ⅓, &c.

What is the fifth part of 30? What is two-fifths? Three-fifths? Four-fifths? Five-fifths?

What is one-sixth of 30? Two-sixths? Three-sixths? Four-sixths? Five-sixths?

30 is how many times 5? How many times 6? How many times 3? How many times 10? How many times 15?

15 is what part of 30? What part of 30 is 10? What part is 6?—5?—2?—1?

How many threes in 30? How many fives? How many sixes? How many tens? How many fifteens in 30?

Six is one-fifth of what number? Three is one-tenth of what number? Two is one-fifth of what number?

If 24 be *four*-fifths of 30, what is *one*-fifth of 30? If 18 be *three*-fifths of 30, what is *one*-fifth? If 12 be *two*-fifths, what is *one*-fifth?

If 25 be *five*-sixths of 30, what is *one*-sixth of 30? If 20 be *four*-sixths of 30, what is *one*-sixth? If 15 be *three*-sixths, what is *one*-sixth? If 10 be *two*-sixths, what is *one*-sixth?

What is the half of a fifteenth of 30? What is the third of one-tenth of 30? What is twice the tenth of 30? What is a sixth of the fifth of 30? What is a fifth of the sixth of 30? What is one-third of one-half of 30?

Subtract the half, third, and tenth of 30 from 30, and what proportion of 30 is left?

Two-thirds of 30 are equal to how many sixths of 30? Three fifths of 30 are equal to how many fifteenths of 30? Five-sixths of 30 are equal to how many fifths of 30? Nine-tenths of 30 are equal to how many thirtieths of 30? Six-fifteenths of 30 are equal to how many fifths of 30;

What is the square of 5; that is, what will 5 multiplied by 5 amount to? What is the square of 6?

How many halves are there in 5 whole numbers? How many halves in 6 whole numbers?

How many whole numbers in 5 halves? How many whole numbers in 6 halves?

How many halfpence are there in 5 pence? How many halfpence in 6 pence?

In 5 halfpence how many pence? In 6 halfpence how many pence?

How many farthings in 5 pence? How many farthings in 6 pence?

How many pence in 30 farthings? How many shillings in 30 pence? How many in 30 sixpences? How many pounds in 30 shillings?

From 2*s.* 6*d.* take one-half of 30 pence? One-third of 30 pence? One-fifth? One-sixth? One-tenth? One-fifteenth? One-thirtieth?

Take from 30 pence two-fifteenths of 30 pence. Half of one-fifteenth of 30 pence. Three-tenths of 30 pence. Two-thirds of 30 pence. Five-fifths of 30 pence.

5 lbs. of meat at 6*d.* per lb.? 6 lbs. at 5*d.* per lb.? 6 yards of ribbon at 5 farthings per yard?

How much money is contained in 5 boxes, each box having 6 pence? How much in six boxes, each having 5 pence? How much in 10 boxes, having 3 pence each? In 15 boxes, having 2 pence each? In 2 boxes, having 15 pence each?

How many hours will a man be travelling 30 miles, if he walk 3 miles an hour? How long will a man be going 30 miles if he ride 6 miles an hour? How long will a steam carriage be going 30 miles at the rate of 15 miles an hour?

A man earns 30 shillings per week, how much does he earn per day?

If a man earns 30 shillings for 6 weeks' work, how much is that per week? For 2?—3?—4?—5 weeks?

If I am charged 3 pence per mile, how many miles can I ride for half a crown? If 5 pence per mile? If 6 pence per mile? If 10 pence per mile? If 15 pence per mile?

How long will it take to lay by half a crown at 3 pence per day? And at 5 pence per day? At 6 pence per week? At 10 pence per week? At 15 pence per week?

If I purchase 10 yards of calico for 30 pence, how much is that per yard? For 5 yards? For 6 yards? For 15 yards?

How many oranges at 5 farthings each can you buy for 30 farthings? How many at 10 each? At 3 farthings each?

How many boxes at 6 farthings each can you buy for 30 farthings?

How many books at 5 pence each can you buy for 30 pence? How many at 2 pence? At 3 pence? At 5 pence? At 6 pence? At 10 pence? At 15 pence?

Give one-fifth of 30 apples among 3 boys, what proportion of 30 will each receive?

If a man had half 30 shillings and paid away one-fifth of what he had, what part of 30 had he left?

If a pound of cherries cost one-sixth of 30 pence, and 2 pounds of raisins cost two-fifths of 30 pence each, how much of 30 pence is left?

John had eleven-fifteenths of 30 nuts and gave to William one-third of 30, how many had he left?

If a man buy 3 medals at two-fifteenths of 30 shillings each, what will he have left of 30 shillings?

How much is 5 times one-sixth of 30? Ten times one-thirtieth of 30? Three times two-fifteenths of 30? Six times two-thirds of 30?

A boy having 30 oranges, gave one-third to his brother, two-fifths to his sister, and one-fifth to his schoolfellow, how many did he give away, and what part of the whole had he left?

If 5 men can build a wall in 6 days, how many men can build it in 1 day? Why can 30 men build it? Because there are 30 days' work. How long then would one man take to build it? If it would take one man 30 days to build it, how long would it take 3 men? Or 5 men? Or 6 men? Or 10 men? Or 15 men?

If two men start from the same place, and travel in opposite directions, and one walk 2 miles an hour, and the other 4 miles an hour, how far will they be apart at the end of 1 hour? When will they be 30 miles apart? How many miles will they be apart at the end of 2 hours? Of 3 hours? Of 5 hours? &c.

A man bought 7 yards and two-thirds of one kind of cloth, 15 yards and three-fifths of another kind, and 6 yards eleven-fifteenths of another kind, how many yards did he buy altogether?

The following Exercise has advantages besides that of producing great expertness in the Tables, and will abundantly repay the slight introductory trouble of the teacher. *Each pupil answers one question and asks another* with as much despatch as possible.

Teacher.	1st Pupil.	2nd Pupil.
5 and 5?	10.—5 from 10?	5.—5 times 5?
3rd Pupil.	4th Pupil.	5th Pupil.
25.—5 in 25?	5 times.—5 and 6?	11.—5 from 11?
6th Pupil.	7th Pupil.	8th Pupil.
6.—5 times 6?	30.—5 in 30?	6 times.—5 and 7?
9th Pupil.	10th Pupil.	11th Pupil.
12.—5 from 12?	7.—5 times 7?	35.—5 in 35?
12th Pupil, &c.		
7 times.—5 and 8?	13.—5 from 13?	8.—5 times 8?
40.—5 in 40?	8 times.—5 and 9?	14.—5 from 14?
9.—5 times 9?	45.—5 in 45?	9 times.—5 and 10?
15.—5 from 15?	10.—5 times 10?	50.—5 in 50?
10.—5 and 11?	16.—5 from 16?	11.—5 times 11?
55.—5 in 55?	11 times.—5 and 12?	17.—5 from 17?
12.—5 times 12?	60.—5 in 60?	12 times.—6 and 6? &c.

After the pupils have become very prompt at this, the money tables may be included.

Teacher.	1st Pupil.	2nd Pupil.
5 and 5?	10.—5 from 10?	5.—5 times 5?
3rd Pupil.	4th Pupil.	5th Pupil.
25.—5 in 25?	5 times.—25 farthings?	$6\frac{1}{4}d.$—25$d.$?
6th Pupil.	7th Pupil.	8th Pupil.
2$s.$ 1$d.$—25 shillings?	1$l.$ 5$s.$—5 and 6?	11.—5 from 11?
9th Pupil.	10th Pupil.	11th Pupil.
6.—5 times 6?	30.—5 in 30?	6 times.—30 farthings?
12th Pupil, &c.		
$7\frac{1}{2}d.$—30 pence?	2$s.$ 6$d.$—30 shillings?	1$l.$ 10$s.$—5 and 7?

ADD SEVERAL SIMPLE NUMBERS TOGETHER, as

9, 8 and 2;——8, 4, 3 and 2;——7, 8, 6, 2 and 3;——4, 2, 8, 7 and 5;——4, 8, 7, 9 and 9;——5, 3, 8, 2, 6 and 4;——3, 7, 8, 2, 5 and 4;——5, 8, 10, 4, 7 and 3.

ADD NUMBERS NOT EXCEEDING 12 TO NUMBERS ABOVE 20:—

As 210 and 8;——123 and 9;——67 and 5;——94 and 9;——45 and 11;——57 and 4;——73 and 12;——197 and 5;——68 and 9;——155 and 11;——598 and 7;——365 and 12;——457 and 6;——88 and 8;——109 and 12;——144 and 9.

SUBTRACT A NUMBER NOT EXCEEDING 12 FROM ONE EXCEEDING 20.

From 84 take 5		From 218 take 12		From 1000 take 11	
63	7	500	11	170	8
120	9	217	9	453	9
95	8	205	8	245	12
68	9	100	7	198	9

MULTIPLY TWO OR MORE FIGURES BY A SINGLE NUMBER, as

21 by 8	15 by 8	716 by 4	444 by 5
44 by 3	31 by 7	327 by 8	97 by 9
95 by 4	85 by 9	415 by 9	378 by 8
27 by 6	42 by 10	242 by 7	279 by 9

DIVIDE A NUMBER EXCEEDING 20 BY ONE UNDER 12, as

5 in 75	3 in 210	7 in 2107	6 in 1728
6 in 120	5 in 4040	9 in 2727	4 in 1728
7 in 343	8 in 576	10 in 410	8 in 1728
4 in 256	9 in 1008	11 in 2200	12 in 1728

DIVIDE SIMPLE FRACTIONAL PARTS OF MONEY NOT EXCEEDING 20*s.*, as

	s.	d.		s.	d.		s.	d.		s.	d.
$\frac{1}{6}$ of	6	8	$\frac{1}{4}$ of	17	0	$\frac{1}{4}$ of	11	2	$\frac{3}{4}$ of	12	0
$\frac{1}{4}$ of	20	0	$\frac{1}{2}$ of	19	0	$\frac{1}{10}$ of	5	0	$\frac{3}{4}$ of	20	0
$\frac{1}{8}$ of	12	0	$\frac{1}{5}$ of	20	0	$\frac{1}{3}$ of	4	3	$\frac{3}{4}$ of	16	0
$\frac{1}{10}$ of	15	0	$\frac{1}{3}$ of	7	9	$\frac{1}{8}$ of	9	10	$\frac{3}{4}$ of	4	0

Add 2*s.* 6¼*d.* and 4*s.* 1*d.* together.
3*s.* 7¼*d.* and 2*s.* 10*d.*
9*s.* 7¾*d.* and 5*s.* 11¼*d.*
12*s.* 7¾*d.* and 7*s.* 7¼*d.*
4*s.* 7¼*d.*, 2*s.* 9*d.* and 13*d.*
5*s.* 5½*d.* and 1*s.* 8*d.*
8*s.* 8½*d.* and 5*s.* 4¾*d.*
11*s.* 7¼*d.* and 4*s.* 3¾*d.*
5*s.* 8¾*d.* and 4*s.* 3¼*d.*
5*s.* 6¼*d.*, 3*s.* 10*d.* and 1*s.* 6*d.*
30*d.*, 17*d.*, 19*d.* and 7*d.*

From a sovereign take 17*s.*——11*s.* 6*d.*——10*s.* 5*d.*——18*s.* 3*d.*——7*s.* 7*d.*——4*s.* 3½*d.*——13*s.* 1¾*d.*——9*s.* 4¼*d.*——1½*d.*——10¼*d.*——9*s.* 9¾*d.*——¼*d.*——1*s.* 1½*d.*——3*s.* 0¼*d.*——1*s.* 11¾*d.*

Multiply—

s. d.		s. d.		s. d.		s. d.	
2 6	by 5	10 8	by 7	5 6½	by 8	12 8½	by 10
4 5	by 3	12 4	by 7	6 7¼	by 2	13 7¼	by 9
7 6	by 6	13 5	by 9	3 10½	by 10	14 5½	by 11
4 3	by 9	15 7	by 10	4 9¾	by 9	15 8½	by 12

Divide—

s. d.		s. d.		s. d.		s. d.	
4 3	by 2	16 3	by 5	14 3½	by 4	15 3½	by 7
8 7	by 4	11 1	by 7	8 6¼	by 3	12 10	by 9
9 4	by 6	10 1½	by 9	13 7¾	by 5	14 11	by 10
12 2	by 12	5 6	by 11	14 1½	by 9	13 1¼	by 12

TO FIND THE VALUE OF A DOZEN ARTICLES.

RULE.—Take the price in pence as shillings, and add for each farthing 3*d.*

Example.—1 doz. yds. at 2*s.* 4*d.* per yard.

2*s.* 4*d.* = 28*d.*, which taken as 28*s.* gives 1*l.* 8*s.* *Ans.*

1 dozen at		4*d.*?	1 dozen at		8½*d.*?
1 —— at		9*d.*?	1 —— at		9¼*d.*?
1 —— at		11*d.*?	1 —— at		10¾*d.*?
1 —— at		12*d.*?	1 —— at		11¼*d.*?
1 —— at	1*s.*	2*d.*?	1 —— at	1*s.*	8¾*d.*?
1 —— at	1*s.*	8*d.*?	1 —— at	3*s.*	4½*d.*?
1 —— at	2*s.*	5*d.*?	1 —— at	10*s.*	5¾*d.*?
1 —— at	5*s.*	4*d.*?	1 —— at	15*s.*	0*d.*?

Because 12 articles at 1*d.* each cost 1 shilling.

VALUE OF ANY NUMBER OF DOZENS.

RULE.—Multiply the value of one dozen by the number of dozens.

Example.—3 doz. at $4\frac{1}{2}d.$ each?

1 doz. at $4\frac{1}{2}d.$ = 4*s.* 6*d.*, which multiplied by 3 gives 13*s.* 6*d.* *Ans.*

4 dozen at	$2\frac{1}{2}d.$ each?	11 dozen at	5*s.* 6*d.* each?
10 —— at	3*d.* each?	6 —— at	1*s.* $8\frac{3}{4}d.$ each?
5 —— at	$4\frac{3}{4}d.$ each?	9 —— at	2*s.* $5\frac{1}{2}d.$ each?
8 —— at	1*s.* 2*d.* each?	11 —— at	6*s.* $8\frac{1}{2}d.$ each?
9 —— at	2*s.* 3*d.* each?	10 —— at	7*s.* 6*d.* each?
96 loaves at	$11\frac{1}{4}d.$ each?	132 pounds at	1*s.* $6\frac{1}{2}d.$ each?
48 yards at	$5\frac{3}{4}d.$ each?	108 tons at	5*s.* $4\frac{1}{4}d.$ each?

Because if 1 dozen cost 1*d.*, 12 dozen will cost 1 shilling.

When the question includes a few over—

RULE.—Calculate the value of the dozens, and add the value of the extra ones.

Example.—75 yards of cloth at $8\frac{3}{4}d.$ per yard?

	d.	£	s.	d.
6 dozen at $8\frac{3}{4}$	=	2	12	6
3 extra at $8\frac{3}{4}$	=	0	2	$2\frac{1}{4}$
		£2	14	$8\frac{1}{4}$ value of 75 yds.

97 yards at	$3\frac{1}{2}d.$ each?	111 yards at	1*s.* $8\frac{1}{4}d.$ each?
39 —— at	6*d.* each?	122 —— at	1*s.* $9\frac{1}{2}d.$ each?
52 —— at	$8\frac{3}{4}d.$ each?	136 —— at	1*s.* $10\frac{3}{4}d.$ each?
65 —— at	2*s.* 1*d.* each?	127 —— at	3*s.* 4*d.* each?
88 —— at	3*s.* 3*d.* each?	134 —— at	5*s.* $6\frac{1}{2}d.$ each?
121 —— at	2*s.* 5*d.* each?	147 —— at	10*s.* $2\frac{1}{4}d.$ each?

TO FIND THE VALUE OF ANY NUMBER OF GROSSES.

RULE.—Find the value of one dozen, and take that amount as the value of one of another dozen.

Example.—1 gross at $4\frac{1}{2}d.$

1 dozen at $4\frac{1}{2}d.$ each is 4*s.* 6*d.*, which, being taken again a pence, gives 54 shillings, the value of one gross at $4\frac{1}{2}d.$ each.

	d.		s.	d.
1 gross at	6 each?	1 gross at	1	$5\frac{3}{4}$ each?
1 ——	$2\frac{1}{2}$ —	2 ——	2	4 —
1 ——	$10\frac{1}{2}$ —	3 ——	4	3 —
1 ——	$4\frac{1}{4}$ —	12 ——	5	$7\frac{1}{2}$ —

Or, take the farthings as shillings, and multiply by 3.

Example.—1 gross at $6\frac{1}{4}d.$

d. s. £ s. d.

$6\frac{1}{4} = 25 \times 3 = 75 = 3\ 15\ 0$, the value of one gross at $6\frac{1}{4}d.$, because in calling farthings shillings, you multiply by 48, which multiplied by 3 gives 1 gross, or 144.

When the number of articles is not easily reducible to dozens, as in $57\frac{3}{4}$, $19\frac{1}{2}$, &c.

RULE.—Take the articles as pence, and multiply by the money.

Example.—$57\frac{3}{4}$ yards at $5d.$ per yard?

$57\frac{3}{4}$ are $4s.\ 9\frac{3}{4}d.$, which, multiplied by 5, gives $1l.\ 4s.\ 0\frac{3}{4}d.$, the answer.

$19\frac{1}{2}$ lbs. at $10d.$ per lb.? $19\frac{1}{2}d. = 1s.\ 7\frac{1}{2}d. \times 10 = 16s.\ 3d.$, the answer; or $19\frac{1}{2}d. \times 10 = 195d. = 16s.\ 3d.$

	d.		d.
$69\frac{1}{4}$ yards at	8	$38\frac{1}{4}$ at	$4\frac{1}{4}$
$45\frac{3}{4}$ ———	5	$78\frac{1}{2}$ at	$10\frac{1}{2}$
$127\frac{1}{2}$ ———	$2\frac{1}{2}$	111 at	$11\frac{1}{4}$

Because $57\frac{3}{4}$ yards at $5d.$ per yard are equal in value to 5 yards at $57\frac{3}{4}d.$ each. So of the others.

TO FIND THE VALUE OF 100 ARTICLES, THE PRICE OF ONE BEING GIVEN.

RULE.—For every farthing take as many pence, and twice as many shillings.

Example.—100 at $2\frac{1}{4}d.$ each.

As many pence = 9
Twice as many shillings = 18 0

18 9 = 100 at $2\frac{1}{4}d.$ each.

	d.		d.		s. d.
100 yards at	4	100 lbs. at	$4\frac{1}{2}$	100 packets of needles at	1 3
100 ———	7	100 ———	$8\frac{1}{4}$	100 ———	2 1
100 ———	10	100 ———	$11\frac{3}{4}$	100 ———	5 0

Because, taking a penny for each farthing is equal to multiplying by 4, and taking 2 shillings for every farthing is equal to multiplying by 96, which together increases the value 100 times.

TO FIND WHAT ANY NUMBER OF PENCE PER DAY WILL AMOUNT TO IN A YEAR.

RULE.—Take the 365 days as pence, which will be 1*l.* 10*s.* 5*d.*, and multiply that sum by the number of pence given.

Example.—What will 5*d.* per day amount to in a year?

1*l.* 10*s.* 5*d.* × 5 = 7*l.* 12*s.* 1*d.*, the answer.

d.		d.	
2 per day for a year.		9 per day for a year.	
5	———	8	———
7	———	11	———

Because 365 days at 5*d.* each are equal to 5 days at 365*d.* or 1*l.* 10*s.* 5*d.* each per day.

Omitting Sundays, the year consists of 313 days, which taken as pence, gives 1*l.* 6*s.* 1*d.*

Example.—If a man spend 4*d.* per day in beer at his work, how much does he spend in the year?

1*l.* 6*s.* 1*d.* × 4 = 5*l.* 4*s.* 4*d.*, the answer.

d.	d.	s. d.
313 days at 7?	313 days at 8½?	313 days at 1 2?
313 - at 8?	313 - at 6¼?	313 - at 2 0?
313 - at 10?	313 - at 9½?	313 - at 2 6?
313 - at 11?	313 - at 10½?	313 - at 5 0?

Add 7*s.* 7¼*d.* for each farthing over in 365 days, and 6*s.* 6¼*d.* for each farthing in 313 days; because 365 farthings equal 7*s.* 7¼*d.*, and 313 farthings equal 6*s.* 6¼*d.*

d.		d.	
6½ per day for 365 days?		2¼ per day for 313 days?	
5¾	———	8½	———
3¾	———	10¾	———
4½	———	9¼	———

ANOTHER RULE.—The amount of any number of pence per day for 365 days may be found by adding together as many POUNDS, HALF-POUNDS, FOURPENCES, and PENCE, as there are pence per day named in the question. For 313 days add as many POUNDS. CROWNS. SHILLINGS, and PENCE.

£	s.	d.	d.
Because 1	0	0 =	240
10	0 =		120
	5 =		5
			365

£	s.	d.	d.
1	0	0 =	240
	5	0 =	60
	1	0 =	12
		1 =	1
			313

If the sum expended per day be shillings—

RULE.—For the year of 365 days multiply 18*l.* 5*s.* by the given number of shillings.

Example.—What will 3*s.* per day amount to in a year?

365*s.* = 18*l.* 5*s.* × 3 = 54*l.* 15*s.*, the *Ans.*

s.	d.	
8	0	per day for a year?
17	0	———
5	6	———
13	3	———

For the year of 313 days the sum to be multiplied will be 15*l.* 13*s.*, because 313 shillings are 15*l.* 13*s.*

s.	d.	
7	0	per day for 313 days?
2	0	———
4	6	———
9	9	———

TO FIND THE VALUE OF A POUND AT ANY PRICE PER OUNCE.

RULE.—Take the price in farthings as shillings, and divide by 3.

Example.—What is the value of 1 lb. of tea at 4½*d.* per oz.

4½*d.* = 18 farthings, 18 ÷ 3 = 6*s.*, the *Ans.*

	d.		s.	d	
What is the value of 1 lb.	at 2	per oz.?	at	10½	per oz.?
———	at 1½	—	at 1	3	—
———	at 4	—	at	9¾	—
———	at 6	—	at 5	0	—

Because, as 48 farthings make 1 shilling, taking a shilling for each farthing is multiplying by 48. But a pound is not 48 ounces, but 16, therefore divide by 3, and you have the value of 16 ounces or 1 lb.

Or,—The number of farthings in the price, multiplied by 4, gives the answer in pence.

Because taking farthings as pence is multiplying by 4.

TO FIND THE VALUE OF AN OUNCE AT ANY PRICE PER POUND.

Rule.—Take the shillings as farthings, and multiply by 3.

Example.—At 8*s.* per lb. what is the cost of an ounce?

8*s.* as farthings $\times 3 = 24$ farthings, the value of 1 oz.

	s.	d.			£	s.	d.
Cost of 1 oz. at	2	0	per lb.?	Cost of 1 oz. at	0	12	6?
———	3	6	—	———	0	15	0?
———	6	0	—	———	0	18	0?
———	7	0	—	———	1	0	0?

Because taking shillings as farthings is equal to dividing by 48 instead of 16.

Or,—The price in pence, divided by 4, gives the answer in farthings.

Because taking pence as farthings is dividing by 4.

TO FIND THE VALUE OF A HUNDREDWEIGHT AT ANY NUMBER OF PENCE PER POUND.*

Rule.—Multiply 9*s.* 4*d.* by the number of pence.

* Another mode of calculating sums in this rule is, for every farthing in the price to take twice as many shillings, and add one-sixth as many.

Example.—112 lbs. at $4\frac{1}{2}d.$ The number of farthings is 18; twice 18 gives 36*s.*; to which add $\frac{1}{6}$, and the answer is 42*s.*, or 2*l.* 2*s.*

Another very simple rule is, for every farthing in the price to take twice as many shillings, and four times as many pence.

Example.—112 lbs. at $4\frac{1}{2}d.$

18 = number of farthings in $4\frac{1}{2}d.$
2
—
36 = twice as many shillings.
6 = 4 times as many pence.
—
42 = value of 112 lbs. at $4\frac{1}{2}d.$ per lb.

Example.—1 cwt. at 1*d.* per lb. is equal to 9*s.* 4*d.*, because 112*d.* are 9*s.* 4*d.*

	d.		d.
1 cwt. at	2 per lb.?	1 cwt. at	5 per lb.?
— at	7 —	— at	11 —
— at	3 —	— at	8 —
— at	9 —	— at	6 —

Because 9*s.* 4*d.* are equal to 112*d.*, or 1 cwt. at 1 penny per lb.

If the price includes farthings, add 2*s.* 4*d.* for one farthing, 4*s.* 8*d.* for two, and 7*s.* for three farthings.

Example.—1 cwt. at $4\frac{3}{4}d.$ per lb. will be 4 times 9*s.* 4*d.*, that is, 37*s.* 4*d.*; and 7*s.* (the value of 1 cwt. at $\frac{3}{4}d.$ per lb.) will make it 44*s.* 4*d.*, the *Ans.*

	d.		d.		d.
1 cwt at	$\frac{1}{4}$?	1 cwt. at	$2\frac{1}{2}$?	1 cwt. at	$10\frac{1}{2}$?
— at	$\frac{1}{2}$?	— at	$4\frac{1}{4}$?	— at	$9\frac{3}{4}$?
— at	$\frac{3}{4}$?	— at	$8\frac{3}{4}$?	— at	$11\frac{1}{2}$?

Because $\frac{1}{4}$ of 9*s.* 4*d.* is 2*s.* 4*d.*—$\frac{1}{2}$ is 4*s.* 8*d.*—$\frac{3}{4}$ are 7*s.*

TO FIND THE VALUE OF A TON AT ANY GIVEN NUMBER OF PENCE PER POUND.

RULE.—Find the value of 1 cwt. as above, and take the shillings as pounds. For 4*d.* over add 6*s.* 8*d.*, and 8*d.* over add 13*s.* 4*d.*

Example.—1 ton at $4\frac{3}{4}d.$, as shown above, will be 44*s.* 4*d.* for the cwt.; 44*s.* being taken as 44*l.*, and 6*s.* 8*d.* added for the 4*d.* over, will give 44*l.* 6*s.* 8*d.* for 1 ton at $4\frac{3}{4}d.$ per lb.

1 ton at	$\frac{1}{4}$ per lb.?	1 ton at	$8\frac{1}{4}$ per lb.?	1 ton at	$7\frac{1}{4}$ per lb.?
— at	$\frac{1}{2}$ —	— at	$9\frac{3}{4}$ —	— at	$10\frac{1}{2}$ —
— at	$\frac{3}{4}$ —	— at	$4\frac{1}{2}$ —	— at	11 —

TO FIND THE VALUE OF ANY NUMBER OF HUNDREDWEIGHTS AND QUARTERS AT 1*d.* PER POUND.

RULE.—Multiply 9*s.* 4*d.* by the number of hundredweights and add 2*s.* 4*d.* for each quarter.

Example.—4 cwt. 3 qrs. at 1*d.* per lb. is equal to 1 cwt. at $4\frac{3}{4}d.$ therefore, as by rule, 9*s.* 4*d.* × 4 = 37*s.* 4*d.* + 7*s.* (for the 3 qrs.) = 44*s.* 4*d.*

cwt.	qr.	d.		cwt.	qr.	d.
5	2	at 1 per lb.?		7	3	at 1 per lb.?
6	1	——		11	1	——
8	3	——		12	2	——
10	2	——		16	3	——

Because 9*s.* 4*d.* are equal to 112 pence.

If, besides hundredweights and quarters, there should be pounds included in the question, the addition of as many pence is obvious.

TO FIND THE VALUE OF A POUND WHEN THE PRICE OF A HUNDREDWEIGHT IS GIVEN.

RULE.—Multiply the price in shillings by 3 and divide by 7, and you have the value of 1 lb. in farthings.

Example.—At 5*l.* per cwt. what is the cost of 1 lb.?

$5l. = 100s. \times 3 = 300 \div 7 = 42\frac{6}{7} = 10\frac{1}{2}d.$ + the value of 1 lb. at 5*l.* per cwt.

	£	s.	
Value of 1 lb. at	3	0	per cwt.?
——	4	12	——
——	6	6	——
——	10	8	——
——	15	10	——
——	8	18	——

Because multiplying by 3, and dividing by 7 and by 48, is equal to dividing by 112.

TO SQUARE A NUMBER.

Add the lower unit to the upper; multiply by the tens, and add the square of the unit.

Example.—Multiply 45 by 45.

Stated thus 50
40

2000
25 = square of the unit 5

2025 = square of 45.

What is the square of 25,——31,——36,——52,——94,——73,——86,——59,——77,——125?

By using the enlarged table, or by transferring the tens and units, larger numbers may be squared in the same way.

This rule is so rarely required, and so limited in its operation, that we hesitated to include it. We have throughout studiously discarded everything which is not general in its application; thus the peculiarities of the number 9, and a host of combinations, rather pretty than useful, have been rejected. The following rule for multiplying by 11 deserves, perhaps, an exception.

To multiply the teens by 11, *place the amount of the two figures between them, thus :—*

11 times 12 = 1(3)2, because 1 and 2 are 3.
11 times 15 = 1(6)5, because 1 and 5 are 6.
11 times 18 = 1(9)8, because 1 and 8 are 9.

Shillings	13	14	15	16	17	18	19	20
Pence	156	168	180	192	204	216	228	240

EXTENDED PENCE TABLE.

d.	£	s.	d.	d.	£	s.	d.	d.	£	s.	d.
100 are	0	8	4	1700 are	7	1	8	3360 are	14	0	0
200 „	0	16	8	1800 „	7	10	0	3400 „	14	3	4
240 „	1	0	0	1900 „	7	18	4	3500 „	14	11	8
300 „	1	5	0	1920 „	8	0	0	3600 „	15	0	0
400 „	1	13	4	2000 „	8	6	8	3700 „	15	8	4
480 „	2	0	0	2100 „	8	15	0	3800 „	15	16	8
500 „	2	1	8	2160 „	9	0	0	3840 „	16	0	0
600 „	2	10	0	2200 „	9	3	4	3900 „	16	5	0
700 „	2	18	4	2300 „	9	11	8	4000 „	16	13	4
720 „	3	0	0	2400 „	10	0	0	4080 „	17	0	0
800 „	3	6	8	2500 „	10	8	4	4100 „	17	1	8
900 „	3	15	0	2600 „	10	16	8	4200 „	17	10	0
960 „	4	0	0	2640 „	11	0	0	4300 „	17	18	4
1000 „	4	3	4	2700 „	11	5	0	4320 „	18	0	0
1100 „	4	11	8	2800 „	11	13	4	4400 „	18	6	8
1200 „	5	0	0	2880 „	12	0	0	4500 „	18	15	0
1300 „	5	8	4	2900 „	12	1	8	4560 „	19	0	0
1400 „	5	16	8	3000 „	12	10	0	4600 „	19	3	4
1440 „	6	0	0	3100 „	12	18	4	4700 „	19	11	8
1500 „	6	5	0	3120 „	13	0	0	4800 „	20	0	0
1600 „	6	13	4	3200 „	13	6	8	4900 „	20	8	4
1680 „	7	0	0	3300 „	13	15	0	5000 „	20	16	8

At this period the pupil should be well acquainted with the tables at pages 18 and 32. By the assistance of them, in conjunction with this pence table, mental calculations within a very large range are easy. But the tables must be well learned, frequently repeated, and the pupil often cross-questioned on them. The answers in these examinations must be instantaneous; the table is not learned when the pupil calculates.

COMBINED TABLE.

	d.	£	s.	d.
13 times 13 are	169	= 0	14	1
13 „ 14 „	182	= 0	15	2
13 „ 15 „	195	= 0	16	3
13 „ 16 „	208	= 0	17	4
13 „ 17 „	221	= 0	18	5
13 „ 18 „	234	= 0	19	6
13 „ 19 „	247	= 1	0	7
13 „ 20 „	260	= 1	1	8
14 times 14 are	196	= 0	16	4
14 „ 15 „	210	= 0	17	6
14 „ 16 „	224	= 0	18	8
14 „ 17 „	238	= 0	19	10
14 „ 18 „	252	= 1	1	0
14 „ 19 „	266	= 1	2	2
14 „ 20 „	280	= 1	3	4
15 times 15 are	225	= 0	18	9
15 „ 16 „	240	= 1	0	0
15 „ 17 „	255	= 1	1	3
15 „ 18 „	270	= 1	2	6
15 „ 19 „	285	= 1	3	9
15 „ 20 „	300	= 1	5	0
16 times 16 are	256	= 1	1	4
16 „ 17 „	272	= 1	2	8
16 „ 18 „	288	= 1	4	0
16 „ 19 „	304	= 1	5	4
16 „ 20 „	320	= 1	6	8
17 times 17 are	289	= 1	4	1
17 „ 18 „	306	= 1	5	6
17 „ 19 „	323	= 1	6	11
17 „ 20 „	340	= 1	8	4
18 times 18 are	324	= 1	7	0
18 „ 19 „	342	= 1	8	6
18 „ 20 „	360	= 1	10	0
19 times 19 are	361	= 1	10	1
19 „ 20 „	380	= 1	11	8
20 times 20 are	400	= 1	13	4

The preceding table is quickly learned in a class by the pupils repeating it together with an easy modulation of voice, thus: 13 times 13 are 169; 169 pence are 14*s.* 1*d.*;—13 times 14 are 182; 182 pence are 15*s.* 2*d.*

Numerous questions of the following kinds are required at this stage of the pupil's progress, and must be answered instantly without calculation:—

13 articles at 17*d.*? 17 yards at 1*s.* 2*d.*? 19 lbs. at 1*s.* 7*d.*?
15 —— 4*d.*? 14 —— 1*s.* 5*d.*? 16 —— 1*s.* 3*d.*?
395*d.*? 2350*d.*? 4320*d.*? 4785*d.*? 5050*d.*?
How many pence in £5 8*s.* 4*d.*? £7 3*s.* 6*d.*? £12 4*s.* 3*d.*? &c.

TO FIND THE VALUE OF ANY NUMBER OF ARTICLES NOT EXCEEDING 5000, BY THE PENCE TABLE.

RULE.—Take the article as pence, and multiply their value, as shown in the table, by the number of pence in the price.

395 yds. at 8*d.* per yd.	685 lbs. at 9*d.* per lb.	1000 at 15*d*
415 —— 11*d.*	1520 —— 10*d.*	2508 — 16*d.*
1111 —— 3*d.*	2166 —— 11*d.*	4040 — 17*d*
2410 —— 7*d.*	4132 —— 5*d.*	5000 — 18*d*

If the price includes shillings, calculate the value of the shillings separately. If the price be an aliquot part of a pound, divide by it; the quotient is pounds.

Example.—4568 yards at 4*s.* 5*d.* per yard.

4*s.* is $\frac{1}{5}$)4568

---

913 12 0 at 4*s.* per yard.
95 3 4 at 5*d.* as in table.

1008 15 4 value of 4568 yd. at 4*s.* 5*d.*

yds. s. d.	yds. s. d.	yds. s. d.
127 at 1 5?	1441 at 3 5?	3302 at 5 5?
250 at 2 1?	1692 at 1 11?	3609 at 5 11?
787 at 2 6?	1288 at 0 $7\frac{1}{2}$?	4085 at 6 7?
1253 at 4 1?	3216 at 3 $7\frac{1}{2}$?	4815 at 10 $4\frac{1}{2}$?

If the tables be well known, these calculations are made almost instantaneously, and even above 5000 very readily.

TO REMOVE FRACTIONS.

RULE.—Double, treble, or increase to any extent, either part of the question, and reduce the other quantity in the same proportion.

Examples.

160 balls at $\frac{3}{4}$ each?	1216 balls at	$3\frac{3}{4}d.$ each?
Say 480 —— $\frac{1}{4}$	Say 608 ——	$7\frac{1}{2}d.$
480 qrs. = 120*d.* = 10*s.*	304 ——	1*s.* 3*d.*
	152 ——	2*s.* 6*d.*
	38 ——	10*s.* 0*d.* £ s. d.
	19 ——	20*s.* 0*d.* = 19 0 0 *Ans*

yds.		d.		lbs.		d.
932	at	$1\frac{1}{4}$	each?	2688	at	$\frac{1}{2}$ $\frac{1}{8}$ per lb.
Say 466	—	$2\frac{1}{2}$		Say 1344	—	$1\frac{1}{4}$ $1s.\ 8d. = £\frac{1}{10}$
233	—	5		672	—	$2\frac{1}{2}$
$116\frac{1}{2}$	—	10		336	—	5

1165*d.* are £4 17*s.* 1*d.* 84 — 1*s.* 8 84÷12=£7, *Ans.*

d.		yds.		£	s.	d.		lbs.		s.	d.
372	at $1\frac{1}{2}$	$67\frac{3}{4}$	at	0	12	0?		288	at 5		$0\frac{3}{4}$
384	— $5\frac{1}{4}$	$74\frac{3}{8}$	—	2	8	0?		$1120\frac{1}{4}$	— 0		$9\frac{3}{4}$
1136	— $6\frac{3}{4}$	$171\frac{1}{8}$	—	0	15	0?		$6528\frac{1}{8}$	— 0		$7\frac{1}{2}$

TO FIND ONE YEAR'S INTEREST AT ANY RATE PER CENT.

RULE.—Multiply the money lent by double the rate per cent., reject the unit figure, and you have the answer in shillings.

Example.—What is the interest of 27*l.* 10*s.* for 1 year at 3 per cent.?

£	s.	d.
27	10	0
		6 = double the rate.
16,5	0	0
12		
6		

16*s.* 6*d. Ans.*

£	s.				£	s.	d.
48	5	at 1	per cent.?	$3\frac{3}{4}$ per cent. on	124	16	0
65	12	— 2	——	4 ——	218	4	0
100	0	— $2\frac{1}{2}$	——	5 ——	350	5	0
352	10	— 3	——	50 ——	1800	15	8

Because rejecting the unit figure is dividing by 10, and taking pounds as shillings is dividing by 20. $10 \times 20 = 200$, which is the true division when the rate per cent. is doubled.

TO FIND THE INTEREST OF ANY SUM OF MONEY AT 5 PER CENT., FOR ANY NUMBER OF MONTHS.

RULE.—Take the pounds as pence (which is instantly done if the table be known), and multiply by the months.

Example.—The interest of 120*l.* at 5 per cent. for 8 months

	s.	d.
120*d.* =	10	0
		8
4	0	0

£	s.			£	s.		
75	0	at 5 per cent. for	4 m.	650	5	at 5 per cent for	5 m.
160	0	———	7	1372	15	———	8
710	10	———	3	4520	10	———	10

As 5 per cent. is $\frac{1}{20}$ part, it follows that the interest of any sum of money at 5 per cent. gives 1*s.* per pound sterling for each year, and consequently 12*d.* for 12 months, or 1*d. per month.* We may, therefore, multiply by the number of years and months, instead of the rate per cent.

TO FIND THE INTEREST OF ANY NUMBER OF DAYS AT 5 PER CENT.

RULE.—Multiply the days by one-third of the pounds, or the pounds by one-third of the days; reject the unit figure, deduct 1*d.* for every 6*s.* and you have the answer in pence.

Example.—What is the interest of 120*l.* for 21 days at 5 per cent.

days.	£
120	21
7 = $\frac{1}{3}$ of 21 days.	40 = $\frac{1}{3}$ of 120*l.*
84|0	84|0 *Ans.* 7*s.*

What is the interest of the following sums at 5 per cent.?

£24 0 for 3 days?	£159 5 for 21 days?
51 0 for 19 days?	515 0 for 30 days?
97 10 for 15 days?	1000 0 for 12 days?
119 15 for 9 days?	1200 0 for 27 days?

360 days taken as a year, 5 days are $\frac{1}{72}$ = 1*d.* in 72*d.* or 6*s.* For any other rate find by this rule, and take the proportion.

TO FIND THE INTEREST OF ANY SUM OF MONEY AT 6 PER CENT., FOR ANY NUMBER OF MONTHS.

RULE.—Multiply the number of pounds by the number of months; cut off the unit figure, and the remainder is the answer in shillings. The unit figure multiplied by 1$\frac{1}{2}$ gives the pence.

Example.—245*l.* at 6 per cent. for 5 months, will give 245.

245
5

122\|5 = 6*l.* 2*s.* 6*d.*

Because 122 shillings are 6*l.* 2*s.*, and the unit figure 5 multiplied by 1$\frac{1}{2}$, gives 6*d.*, making together 6*l.* 2*s.* 6*d.*

£			£	s.			
15 at 6 per cent. for	3 m.		52	10 at 6 per cent. for	2 yrs.	6 m.
50 ———	4		46	5 ———	1	8
120 ———	5		74	0 ———		10
510 ———	8		100	0 ———	3	4
1000 ———	10		500	0 ———	5	10

TO FIND THE INTEREST OF ANY SUM OF MONEY AT 4 PER CENT., FOR ANY NUMBER OF MONTHS.

RULE.—Proceed as for 6 per cent., and subtract one-third from the result.

Example.—240*l.* at 4 per cent., for 8 months.

$240 \times 8 = 192|0 = 9l.\ 12s.$; subtracting one-third, I have 6*l.* 8*s.*, *Ans.*

£	s.			£	s.		
200	0 at 4 per cent. for	3 m.		520	15 at 4 per cent. for	7 m.	
350	0 ———	5		680	10 ———	11	
187	10 ———	8		950	0 ———	10	
200	0 ———	10		1200	0 ———	11	

TO FIND THE INTEREST OF ANY SUM OF MONEY AT 3 PER CENT., FOR ANY NUMBER OF MONTHS.

RULE.—Proceed as for 6 per cent., and take half the result.

What is the interest, at 3 per cent., of 27*l.* 10*s.* for 3 m.? 51*l.* 12*s.* 6*d.* for 7 m.? 194*l.* 2*s.* 6*d.* for 10 m.?

TO FIND THE INTEREST OF ANY SUM OF MONEY AT 2 PER CENT., FOR ANY NUMBER OF MONTHS.

RULE.—Proceed as for 6 per cent., and take one-third.

73*l.* 7*s.* for 5 m.? 88*l.* 8*s.* 11*d.* for 1 m.? 261*l.* 15*s.* 8*d.* for 9 m.?

TO FIND THE INTEREST FOR ANY NUMBER OF HALVES PER CENT.

RULE.—Double the rate per cent., and proceed as for 6 per cent.

Example.—282*l.* at $3\frac{1}{2}$ per cent. for 1 year?

282

7 halves $= 3\frac{1}{2}$

$197|4 = 9\frac{3}{4}$. 17*s.* $4\frac{1}{4}d$ *Ans.*

£	s.		£	s.	
Interest of 200	0 at 2½	per cent.	Interest of 950	10 at 2½	per cent.
420	0 at 4½	——	1200	0 at 5½	——
666	10 at 1½	——	752	12 at 3½	——

£		£	s.		£
½ per cent. on 120	¾ per cent. on	400	0	⅛ per cent. on	1000
¼ —— 50	1½ ——	515	10	⅜ ——	5000

Multiplying by halves doubles the rate per cent.; cutting off the unit is dividing by 10, and taking pounds as shillings is dividing by 20; that is, multiplying by 2 and dividing by 200.

TO FIND THE INTEREST FOR ANY TIME, AT ANY RATE PER CENT., WHEN AN ALIQUOT PART OF 1200.

RULE.—Multiply the time *in months* by the rate, and find how many times the product is contained in 1200; the quotient is the divisor.

Ex.—Interest of 324*l.* 10*s.* 6¾*d.* for 4 years 2 months, at 3 per cent.

yrs. m. mths.		£ s. d.	
4 2 = 50 × 3 = 150)	1200	8)324 10 6¾	
	8	40 11 3¾	*Ans.*

	£	s.	d.	yrs. mo.	
What is the interest of	10	7	6	for 0 2	at 6 per cent.?
What is the interest of	20	10	8	for 0 5	at 6 per cent.?
What is the interest of	53	14	3	for 0 5	at 4 per cent.?
What is the interest of	85	16	1	for 6 8	at 5 per cent.?
What is the interest of	92	13	0	for 2 1	at 6 per cent.?
What is the interest of	153	5	8½	for 8 4	at 4 per cent.?

TO FIND THE INTEREST OF ANY SUM OF MONEY FOR ANY NUMBER OF YEARS, MONTHS, AND DAYS, AT ANY RATE PER CENT.

RULE.—Multiply by double the rate per cent., reject the unit figure, and you have the interest in shillings for 1 year at the required rate per cent.

Example.—What is the interest of 120*l.* at 4½ per cent. for 3 years, 1 month, 15 days?

120
9 halves.

		£	s.	d.	
108|0	=	5	8	0	for 1 year.
				$3\frac{1}{8}$	years.
		16	4	0	
			13	6	
		16	17	6	= interest for 3 years, 1 m. 15 d.

What is the interest of the following sums?

£	s.				
45	10	at 2	per cent.	for 1 year, 3	months, 10 days.
100	0	at $3\frac{1}{2}$	——	for 2 years, 8	months, 24 days.
87	15	at $1\frac{1}{2}$	——	for 1 year, $9\frac{1}{2}$	months,
218	5	at 4	——	for 3 years,	7 days.
365	0	at 5	——	for 7 years, 4	months, 19 days.
1020	0	at $8\frac{1}{2}$	——	for 10 years, 9	months, 21 days.

Specimen of what is called the Pestalozzian Mode of proving Arithmetical Operations, which is recommended for occasional exercise.

How many times are $2\frac{2}{3}$ contained in $3\frac{3}{4}$? *Ans.* $1\frac{1}{3}\frac{3}{2}$.

In $2\frac{2}{3}$ are $\frac{8}{3}$—in $3\frac{3}{4}$ are $\frac{15}{4}$—in $\frac{8}{3}$ are $\frac{32}{12}$—in $\frac{15}{4}$ are $\frac{45}{12}$. $\frac{32}{12}$ are contained in $\frac{45}{12}$ once and $\frac{1}{3}\frac{3}{2}$ over.

7-eighths of 15*s.*? *Ans.* 13*s.* $1\frac{1}{2}d.$

The 8th of 15 is $\frac{15}{8}$. 7 times the 8th of 15 is 7 times $\frac{15}{8}$, which is $\frac{105}{8}$, which are 13 whole numbers and $\frac{1}{8}$. $\frac{1}{8}$ of 1*s.* is $1\frac{1}{2}d.$ The answer, therefore, is 13*s.* $1\frac{1}{2}d.$

If 5-sixths of a yard cost 6*s.* 3*d.*, how much cost 7-eighths of a yard?—*Ans.* 6*s.* $6\frac{3}{4}d.$

In $\frac{1}{6}$ are $\frac{4}{24}$, in $\frac{5}{6}$ are 5 times $\frac{4}{24}$; 5 times $\frac{4}{24}$ are $\frac{20}{24}$. In $\frac{1}{8}$ are $\frac{3}{24}$, in $\frac{7}{8}$ are 7 times $\frac{3}{24}$, which are $\frac{21}{24}$. If $\frac{20}{24}$ cost 6*s.* 3*d.*, $\frac{21}{24}$, which are 21 times $\frac{1}{20}$ of $\frac{20}{24}$, cost $\frac{21}{20}$ of 6*s.* 3*d.* In 6*s.* 3*d.* are 75*d.*; $\frac{1}{20}$ of 75*d.* is $3\frac{3}{4}d.$; 21 times the $\frac{1}{20}$ of 75*d.* are 21 times $3\frac{3}{4}d.$; 21 times $3\frac{3}{4}d.$ are 6*s.* $6\frac{3}{4}d.$

7 is to $12\frac{1}{4}$ as 9 is to what number?—*Ans.* $15\frac{3}{4}$.

In 7 whole numbers are $\frac{28}{4}$, in $12\frac{1}{4}$ are $\frac{49}{4}$; 49 are 7 times 7; 28 are 4 times 7; 7 times 7 are 7 times the $\frac{1}{4}$ of 4 times 7; therefore, as 7 is to 7 times the 4th of 7, so is 9 to 7 times the 4th of 9. The $\frac{1}{4}$ of 9 is $\frac{9}{4}$; 7 times $\frac{1}{4}$ of 9 is 7 times $\frac{9}{4}$, that is, $\frac{63}{4}$; $\frac{63}{4}$ are $15\frac{3}{4}$.

MISCELLANEOUS QUESTIONS

ON

MENTAL ARITHMETIC.

1. Twice the half of two?
2. Five times 6 are how many times 3?
3. A man who owned $\frac{3}{4}$ of a vessel sold $\frac{1}{3}$ of his share; what portion remained to him?
4. A stage-coach and a man on foot started from London at the same time; the coach progressed at the rate of 7 miles an hour, the man went but 4; how far distant were they at the expiration of an hour?
5. If 8 be the twelfth part of any number, what is twice that number?
6. A cow cost 12 sovereigns, and 5*l.* for keeping, but she yielded 21*l.* worth of milk, and was sold for 11*l.*; how much money was gained by her?
7. Fifteen yards at $15\frac{1}{2}$ shillings per yard?
8. How many squares on a chess-board which has 8 each side?
9. If there be provisions for 12 men 10 days, how many days would there be provisions for 15 men?
10. A man wrought 6 days for 18 shillings; which is the largest portion of his wages, $\frac{1}{2}$, $\frac{3}{6}$, ·5, or 3 days' wages?
11. How many quarters are there in $\frac{2}{3}$ of $\frac{3}{4}$ of a plum-pudding?—Why?
12. If a yard of velvet cost 16*s.*, what will $\frac{1}{4}$ of $\frac{1}{4}$ of a yard cost?
13. What is once 4 and three-fourths of four?
14. What is the seventh part of a seventh of 49?
15. An officer riding after a chaise was a mile behind it, but he gained 10 yards a minute; in what time will he overtake it?
16. If a pencil and a half be worth three-halfpence, what is the value of 19 pencils?
17. Seven times seven and $\frac{5}{7}$ of 7? 9 times 9 and $\frac{4}{9}$ of 9?
18. Eleven times 11 and $\frac{9}{11}$ of 11? 12 times 12 and $\frac{7}{12}$ of 12?
19. How many yards 5 quarters wide are equal to 20 yards of 3 quarters wide?
20. If a yard of cloth 4 quarters wide is worth 1*l.*, what is a yard 5 quarters wide worth?
21. In $6\frac{1}{4}$, how many fourths? In $10\frac{4}{5}$, how many fifths?
22. In $\frac{25}{4}$, how many whole numbers? In $\frac{64}{5}$, how many times 1?
23. If I purchase at 45*l.*, and sell for $\frac{5}{6}$ of the cost, what do I lose?

24. A meter in a certain river is $\frac{4}{5}$ in the water and 8 feet out; what is the whole height of it?
25. A fox is 600 yards in advance when a hound pursues it; the dog runs 220 yards in a minute, the fox only 205; when will the hound overtake it?
26. If I buy 120 gallons of wine, and lose $\frac{3}{5}$ of it, what must I charge per gallon to sell the remainder for 40*l.*?
27. Eight is $\frac{4}{5}$ of what number? 9 is $\frac{9}{10}$ of what number? 4 is $\frac{2}{11}$ of what number? 5 is $\frac{10}{24}$ of what number?
28. A gentleman having 50*s.* to pay among his work-people, gave to each man 1*s.*, to each woman 8*d.*, to each boy 4*d.*, the number of each class being equal; what was the number?
29. How many times will a hoop which is a yard in circumference turn in rolling 3 miles?
30. How many pence in 19*s.* $5\frac{1}{4}$*d.*? In 1*l.* 16*s.* 5*d.*? In 5*l.* 8*s.* 4*d.*? In 10*l.* 3*s.* $7\frac{1}{2}$*d.*? In 3*l.* 2*s.* $9\frac{1}{4}$*d.*?
31. What is the difference between 4 times 5 & 20, and 4 times 25?
32. If I buy an article for 3*d.*, and sell it for 4*d.*, what do I gain per cent.?

	s. d.	s. d.	s. d.
33.	3 ozs. at 5 0 per lb.?	5 ozs. at 4 6?	7 ozs. at 12 0?
34.	8 ozs. at 8 0 per lb.?	2 ozs. at 10 0?	11 ozs. at 15 6?
35.	2 lbs. at 0 4 per oz.?	6 lbs. at 0 $4\frac{1}{2}$?	10 lbs. at 0 $8\frac{3}{4}$?
36.	5 lbs. at 0 5 per oz.?	9 lbs. at 0 $2\frac{1}{4}$?	12 lbs. at 0 $9\frac{1}{2}$?

37. In 240 yards of cloth how many English ells? How many French ells? How many Flemish ells?
38. What is the difference between six dozen dozen and half a dozen dozen?
39. 2 dozen at $3\frac{1}{2}$*d.* each? 5 dozen at $6\frac{1}{4}$*d.*? 11 dozen at $10\frac{1}{2}$*d.*?
40. 2 gross at $3\frac{1}{2}$*d.* each? 8 gross at $2\frac{3}{4}$*d.*? 10 gross at $6\frac{3}{4}$*d.*?
41. 73 yards at $4\frac{1}{4}$*d.* per yard? 97 lbs. at $7\frac{1}{2}$*d.* per lb.? 86 stone at $8\frac{1}{2}$*d.* per stone?
42. A loaf and a half cost 18*d.*; what will $10\frac{3}{4}$ loaves cost?
43. 243 yards at 5*d.* per yard? $369\frac{1}{2}$ yards at 4*d.* per yard? 1265 lbs. at 7*d.* per lb.?
44. Of three children in a family, the eldest received 3*d.* per week, the next 2*d.* per week, the youngest 1*d.* per week; what did the whole sum amount to in a year?
45. 20 yards at 17*s.* $1\frac{1}{2}$*d.* per yard? 20 at 19*s.* 4*d.* each? 20 at 8*l.* 18*s.* 3*d.* each? 6 pieces of cloth, each 20 yards, at 12*s.* 6*d.* per yard?
46. If the eighth of a pound sterling be 3*s.*, what will one-fifth of a 5*l.* note be?
47. If $\frac{3}{4}$ of a hundred weight cost 15*s.*, what will $97\frac{1}{2}$ cwt. cost?

48. 96 yards at $10\frac{3}{4}d.$ per yard? 120 lbs. at $2s.$ $1\frac{1}{2}d.$ per lb.? 84 yards at $4s.$ $2\frac{1}{4}d.$ per yard? 144 yards at $5s.$ $5\frac{1}{4}d.$?
49. How many times will a penny piece of three inches in circumference turn in rolling 100 yards?
50. 4 times 5 and 2-fifths of 5 are how many times 11?
51. 6 times 7 and 6-sevenths of 7 are how many times the half of 8?
52. 10 times 10 and 8-tenths of 10 are how many times the half of 1?
53. If I distribute 5-ninths of 108 nuts among 12 boys, how many do I give to each?
54. 3-fifths of 120 is $\frac{4}{5}$ of how many times 10?
55. 5-sixths of 36 is $\frac{2}{3}$ of how many times 3?
56. 3-sevenths of 84 is $\frac{4}{9}$ of how many thirds of 9?
57. A boy earned $11d.$ per day, and gave $2d.$ away each Sunday; how much did his wages for the year exceed his gifts?
58. What will a pint and a half of porter per day cost in a year, at $2d.$ per pint?
59. At $1d.$ per lb. what is the value of 8 cwts. 3 qrs.? Of 9 cwts. 2 qrs.? Of 12 cwts. 1 qr.?
60. At $1d.$ per lb., what is the value of 1 ton? Of 1 ton 10 cwts.? Of 1 ton 4 cwts. 3 qrs.?
61. What is the yearly expense of bread at $4\frac{3}{4}d.$ per day?
62. 18 times 324? 15 times 410? 17 times 365? 19 times 1254?
63. Two vessels start at the same time, one from London, at the rate of 10 miles an hour, the other from Leith, at the rate of 6 miles an hour; when will they meet, supposing the places distant 480 miles? and what distance will each have then sailed?
64. $37\frac{1}{2}$ yards at $7d.$ per yard? $49\frac{1}{4}$ at $8\frac{1}{2}d.$ each? $64\frac{3}{4}$ at $9d.$?
65. 24010 lamp glasses at $3\frac{1}{2}d.$ each? 4104 loaves at $5d.$ each?
66. What cost 1500 rations of bread at $2\frac{1}{5}d.$ each? 2888 inkstands at $9\frac{1}{4}d.$ each?
67. 1195 lbs. at $8d.$ per lb.? 2407 lbs. at $10d.$ per lb.? 528 lbs. at $8\frac{3}{4}d.$ per lb.?
68. What is the cost of 1 cwt. at $8\frac{1}{4}d.$ per lb.? At $7\frac{3}{4}d.$? At $9\frac{1}{4}d.$? At $10\frac{1}{2}d.$? At $11\frac{3}{4}d.$?
69. A dealer bought cloth at $18d.$ per yard, and sold it at $1s.$ $10\frac{1}{2}d.$ per yard; what did he gain in the sale of 36 yards? and what was his gain per cent.?
70. Two men barter: one has 12 cows, at $7l.$ $5s.$ each, the other 7 horses, worth $13l.$ each; what is the difference in value in half-crowns?
71. What is the commission on $2000l.$ at $1\frac{1}{8}$ per cent.? What is the brokerage on $500l.$ at $\frac{1}{8}$ per cent.?
72. Multiply a halfpenny by a halfpenny, that is, half by half; prove the answer by decimals and duodecimals.

73. Multiply the nine digits together.
74. A grocer mixes 25 lbs. of tea at 4*s.* per lb., with 80 lbs. at 5*s.* per lb.; what will a pound of the mixture be worth?
75. 100 yards at $2\frac{1}{2}d.$ per yard? 100 lbs. at $11\frac{3}{4}d.$ per lb.? 10 stone at 2*s.* $6\frac{1}{2}d.$ each?
76. At 12 lbs. for 7*s.* 6*d.*, what cost 1 cwt.?
77. If I purchase 100 yards of ribbon at 3 yards for a shilling, and 100 yards more at 5 yards for a shilling, and sell the whole at 8 yards for 2 shillings, what do I gain or lose?

		s.	d.			s.	d.			s.	d.
78.	12832 at	0	$3\frac{3}{4}$ each?	3265	at	0	$7\frac{1}{2}$?	7253 at	0	10?	
79.	4977 at	1	3?	$936\frac{1}{2}$	at	1	4?	51720 at	1	8?	
80.	2644 at	2	6?	8545	at	3	4?	7502 at	6	8?	
81.	6251 at	4	0?	9203	at	5	0?	961 at	13	4?	
82.	2104 at	6	0?	5412	at	8	0?	7345 at	10	0?	
83.	8411 at	12	0?	6802	at	14	0?	2408 at	15	0?	

84. What is the square of 4? 7? 10? 16? 20?
85. What is the cube of 3? 6? 9? 10? 12?
86. What is the fourth power of 2? 5? 6? 8? 10?
87. What is the fifth power of 1? 2? 3? 4? 5?
88. What is the square root of 81? 100? 64? 121? 144?
89. What is the cube root of 8? 27? 125? 343? 1728?
90. What is the nearest square root to 5? 50? 85? 500?
91. What is the nearest cube root to 9? 45? 648? 1000?
92. If a garrison of 400 men have provisions for 10 months, how many men must depart at the end of five months for the provisions to last 13 months?
93. Bought a ton of lead at $3\frac{1}{2}d.$ per lb., retailed it at $5\frac{1}{4}d.$ per lb.; what was the gain on the whole?
94. If I buy a gross of ivory rulers for $7\frac{1}{4}d.$ each, and sell them for 10*d.* each, what do I gain on the gross?
95. Paid 50*l.* for a ton of litharge, retailed it at 6*d.* per lb.; what was the gain on 14 tons?
96. A. has 280 yards of cloth at 10*s.* per yard, for which B. gives him 59*l.* 10*s.* in money, and sugar at 6*d.* per lb.; how much sugar did B. give him?
97. What is the interest of the following sums of money at 5 per cent.:—250*l.* for 5 months? 2765*l.* 10*s.* for 8 months? 4082*l.* 15*s.* 10*d.* for 10 months? 79*l.* for 3 months? 1690*l.* 12*s.* for 6 months? 5000*l.* for 11 months?
98. What is the interest of the following sums of money at 6 per cent:—120*l.* for 4 months? 85*l.* 10*s.* for 3 months? 784*l.* 15*s.* for 9 months? 248*l.* for 5 months? 185*l.* for 6 months? 2641*l.* 10*s.* for 11 months?
99. $\frac{1}{2}$ per cent. on 35*l.*? On 84*l.*? On 115*l.* 10*s.*? On 950*l.* 15*s.*

100. $3\frac{1}{2}$ per cent. on 47*l.* 10*s.*? $7\frac{1}{2}$ on 180*l.*? $1\frac{3}{4}$ on 100*l.*?
101. What is the interest of the following sums at 4 per cent.:— 25*l.* 10*s.* for 4 months? 92*l.* 16*s.* for 3 months? 327*l.* for 8 months? 1200*l.* for 9 months?
102. What is the interest of the following sums at 3 per cent.:— 35*l.* 15*s.* for 2 months? 52*l.* for 7 months? 145*l.* 8*s.* for 15 months? 9*l.* 19*s.* for 10 months?
103. What is the interest of the following sums at 2 per cent.:— 61*l.* 10*s.* for 1 month? 85*l.* 10*s.* for 6 months? 142*l.* 7*s.* for 4 months? 455*l.* 6*s.* for 8 months?

	£	s.	d.	yrs.	pr. cent.	£	s.	d.	yrs.	pr. ct.
104.	560	0	0	for 4	at 5?	87	10	0	for 5	at 4?
105.	840	0	0	for 1	at 5?	9837	14	10	for $12\frac{1}{2}$	at 4?
106.	759	13	$8\frac{1}{2}$	for 10	at 5?	1244	13	4	for 5	at 5?
107.	945	15	6	for 4	at $8\frac{1}{3}$?	2000	0	0	for 5	at 8?

108. Reduce 12*s.* $6\frac{1}{4}$*d.* to the decimal of a pound sterling.
109. What is the value of the decimal ·835*l.*? ·42 of a shilling?
110. What is the value of ·618 of a cwt.? ·52 of a ton? ·9 of 1 lb. avoirdupois?
111. What is the $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{5}{6}$ of 4? $\frac{3}{4}$ of $\frac{5}{8}$ of $2\frac{1}{4}$? $\frac{1}{8}$ of $\frac{8}{9}$ of $\frac{1}{2}$ of $6\frac{1}{4}$?
112. What decimals are equal to the following vulgar fractions:— $\frac{1}{2}$? $\frac{5}{8}$? $\frac{3}{4}$? $\frac{5}{1\frac{1}{2}}$? $\frac{2}{1\frac{1}{1}}$? $\frac{3}{1\frac{1}{0}}$? $2\frac{1}{2}$?
113. What fraction of a pound sterling is 1*s.* $3\frac{1}{4}$*d.*? 3*s.* $4\frac{1}{4}$*d.*? 16*s.* 6*d.*? 19*s.* $3\frac{3}{4}$*d.*?
114. Add $\frac{5}{6}$ of a shilling to $\frac{15}{16}$ of a pound sterling.
115. Take $\frac{3}{4}$ of a pound sterling and $\frac{5}{8}$ of a shilling from $5\frac{3}{1\frac{1}{2}}$*l.*
116. Take away the 4th, 5th, and 6th of a number, and the remainder is 138; what is the number?
117. In a family of eight children, the father, during four successive years, gave a weekly sum to each child, according to seniority, from 1*d.* to the youngest to 8*d.* the eldest; what was the whole amount of their father's gifts?
118. What sum given for an estate of a clear rental of 48*l.* per annum, will yield 4 per cent.?
119. What is the value of a pipe of wine at 9*s.* 2*d.* per gallon?
120. If the first term of a Rule of Three question be 4, the third term 5, and the fourth term 20, what is the second term?
121. If the second term be 10, the third term 19, the fourth term 76, what is the first term?
122. If the first term be 21, the second term 189, the fourth term 45, what is the third term?
123. If the first term be 50, the second term 1000, the third term 17, what is the fourth term?

BILLS OF PARCELS.

When goods are bought a bill is given with them, which should be made out after the following forms :—

Mr. Simpson

To John Dowlas.

1832

Dec. 27.	s.	d.		£	s.	d.
18 yards Irish cloth .....at	4	6	per yard	4	1	0
28 yards Holland .....at	2	6	——	3	10	0
5 yards cambric muslin at	12	6	——	3	2	6
16 yards diaper clouting at	2	8	——	2	2	8
				£12	16	2

Thomas Smeathers, Esq.

To John Oliver.

1832

Sept. 19.	s.	d.		£	s.	d.
16 yards superfine broad cloth at	27	6	per yard			
18 yards second ditto .....at	14	9	——			
13 yards brown ditto .....at	11	10	——			
14¼ yards scarlet ditto .....at	24	4	——			
62¾ yards black kerseymere.....at	9	8	——			
				£90	12	8

T. Reseigh, Esq.

To Timothy Fig.

1833

Oct. 19.	s.	d.		£	s.	d.
¼ lb. fine gunpowder tea at	16	4	per lb.			
1½ lb. souchong .....at	9	6	- ——			
¾ lb. hyson .....at	11	4	- ——			
17½ lb. loaf sugar.....at		9	——			
¼ lb. allspice .....at	6	6	——			
½ lb. ginger .....at	2	9	——			
				£2	2	11½

Mr. Jonathan Soames

To James Cornish.

1833		s.	d.		£	s.	d.
Dec. 3.	14½ short moulds at	1	3	per lb.			
	15 common dips at	1	1½	——			
	19½ white soap ...at		9¼	——			
	17 yellow ditto..at		8¾	——			
	2 wax tapers ...at	4	6	each.			
					£3	11	5

BILLS OF BOOK DEBTS.

The following is the manner in which bills should be made out when copied from a tradesman's book, supposing the bill of parcels not paid on the delivery of the goods.

Mr. John Dowson

To Thomas Wallis.

1833				£	s.	d.
Jan. 25	To goods as per Bill delivered			25	19	6¼
Mar. 18	,,	,,	,, ...	19	12	5½
June 19	,,	,,	,, ...	17	15	6¼
Aug. 24	,,	,,	,, ...	19	18	11½
Nov. 17	,,	,,	,, ...	28	16	3½
				£112	2	9

FORMS OF RECEIPT.

London, July 20th, 1832.

Received of Mr. Francis Doncy, the sum of one hundred and forty-two pounds, sixteen shillings, and nine pence, for work done as per bill.

£142 16*s.* 9*d.* John Bricklayer.

Received, January 1st, 1833, of Mr. James Bonwick, the sum of ten pounds, fifteen shillings, the amount of one quarter's rent, due at Christmas last.

£10 15*s.* 0*d.* Robert Saunders.

ANSWERS TO QUESTIONS IN MENTAL ARITHMETIC.

Calculations by Dozens. Page 117.

4*s.* 9*s.* 11*s* 12*s.* 14*s.* 20*s.* 1*l.* 9*s.* 3*l.* 4*s.*
8*s.* 6*d.* 9*s.* 3*d.* 10*s.* 9*d.* 11*s.* 3*d.* 1*l.* 0*s.* 9*d.* 2*l.* 0*s.* 6*d.*
6*l.* 5*s.* 9*d.* 9*l.*

Any Number of Dozens. Page 118.

10*s.* 1*l.* 10*s.* 36*l.* 6*s.* 6*l.* 4*s.* 6*d.* 1*l.* 3*s.* 9*d.*
5*l.* 12*s.* 12*l.* 3*s.* 4*l.* 10*s.* 1*l.* 3*s.* 13*l.* 5*s.* 6*d.*
44*l.* 5*s.* 6*d.* 45*l.* 10*l.* 3*s.* 6*d.* 28*l.* 18*s.* 3*d.*

Dozens and Odd Numbers. Page 118.

1*l.* 8*s.* 3½*d.* 19*s.* 6*d.* 1*l.* 17*s.* 11*d.* 6*l.* 15*s.* 5*d.*
14*l.* 6*s.* 14*l.* 12*s.* 5*d.* 9*l.* 7*s.* 3¾*d.* 10*l.* 18*s.* 7*d.*
12*l.* 17*s.* 10*d.* 21*l.* 3*s.* 4*d.* 37*l.* 2*s.* 7*d.* 74*l.* 17*s.* 6¾*d.*

Grosses. Page 118.

3*l.* 12*s.* 1*l.* 10*s.* 6*l.* 6*s.* 2*l.* 11*s.* 10*l.* 13*s.*
33*l.* 12*s.* 91*l.* 16*s.* 486*l.*

Irregular Numbers. Page 119.

2*l.* 6*s.* 2*d.* 19*s.* 0¾*d.* 1*l.* 6*s.* 6¾*d.* 13*s.* 6½*d.*
3*l.* 8*s.* 8¼*d.* 5*l.* 4*s.* 0¾*d.*

100 *Articles.* Page 119.

1*l.* 13*s.* 4*d.* 2*l.* 18*s.* 4*d.* 4*l.* 3*s.* 4*d.* 1*l.* 17*s.* 6*d.*
3*l.* 8*s.* 9*d.* 4*l.* 17*s.* 11*d.* 6*l.* 5*s.* 10*l.* 8*s.* 4*d.* 25*l.*

365 *Days.* Page 120.

3*l.* 0*s.* 10*d.* 7*l.* 12*s.* 1*d.* 10*l.* 12*s.* 11*d.* 13*l.* 13*s.* 9*d.*
12*l.* 3*s.* 4*d.* 16*l.* 14*s.* 7*d.*

313 *Days.* Page 120.

9*l.* 2*s.* 7*d.* 10*l.* 8*s.* 8*d.* 13*l.* 0*s.* 10*d.* 14*l.* 6*s.* 11*d.*
11*l.* 1*s.* 8½*d.* 8*l.* 3*s.* 0¼*d.* 12*l.* 7*s.* 9½*d.* 13*l.* 13*s.* 10½*d.*
18*l.* 5*s.* 2*d.* 31*l.* 6*s.* 39*l.* 2*s.* 6*d.* 78*l.* 5*s.*

Farthings in 365 *Days.* Page 120.

9*l.* 17*s.* 8½*d.* 8*l.* 14*s.* 10¾*d.* 5*l.* 14*s.* 0¾*d.* 6*l.* 16*s.* 10½*d.*

Farthings in 313 *Days.* Page 120.

2*l.* 18*s.* 8¼*d.* 11*l.* 1*s.* 8½*d.* 14*l.* 0*s.* 4¾*d.* 12*l.* 1*s.* 3¼*d.*

Shillings per Year of 365 *Days.* Page 121.

146*l.* 310*l.* 5*s.* 100*l.* 7*s.* 6*d.* 241*l.* 16*s.* 3*d.*

Shillings per Year of 313 *Days.* Page 121.

109*l.* 11*s.* 31*l.* 6*s.* 70*l.* 8*s.* 6*d.* 152*l.* 11*s.* 9*d.*

Pounds at per Ounce. Page 121.

2*s.* 8*d.* 2*s.* 5*s.* 4*d.* 8*s.* 14*s.* 1*l.* 13*s.* 4*l.*

Ounces at per Pound. Page 122.

1½*d.* 2½*d.*+ 4½*d.* 5¼*d.* 9¼*d.*+ 11¼*d.*
1*s.* 1½*d.* 1*s.* 3*d.*

Hundredweights at Pence per lb. Page 123.

18*s.* 8*d.* 3*l.* 5*s.* 4*d.* 1*l.* 8*s.* 4*l.* 4*s.* 2*l.* 6*s.* 8*d*
5*l.* 2*s.* 8*d.* 3*l.* 14*s.* 8*d.* 2*l.* 16*s.*

Hundredweights at Pence and Farthings per lb. Page 123.

2*s.* 4*d.* 4*s.* 8*d.* 7*s.* 1*l.* 3*s.* 4*d.* 1*l.* 19*s.* 8*d*
4*l.* 1*s.* 8*d.* 4*l.* 18*s.* 4*l.* 11*s.* 5*l.* 7*s.* 4*d.*

Value of a Ton. Page 123.

2*l.* 6*s.* 8*d.* 4*l.* 13*s.* 4*d.* 7*l.* 77*l.* 91*l.* 42*l.*
67*l.* 13*s.* 4*d.* 98*l.* 102*l.* 13*s.* 4*d.*

Hundredweights and Quarters. Page 124.

2*l.* 11*s.* 4*d.* 2*l.* 18*s.* 4*d.* 4*l.* 1*s.* 8*d.* 4*l* 18*s*
3*l.* 12*s.* 4*d.* 5*l.* 5*s.* 5*l.* 16*s.* 8*d.* 7*l.* 16*s.* 4*d.*

Pounds at per Hundredweight. Page 124.

6¼*d.* + 9¾*d.* + 1*s.* 1½*d.* 1*s.* 10¼*d.* + 2*s.* 9*d.* + 1*s.* 7*d.* +

Square of a Number. Page 124.

625. 961. 1296. 2704. 8836. 5329.
7396. 3481. 5929. 15625.

Pence in Pounds, Shillings, and Pence. Page 126.

1300. 607. 1722. 2466. 2931. 2214. 3664. 1726
2694. 3188. 3874 3785.

Articles not exceeding 5000. Page 127.

13*l.* 3*s.* 4*d.* 19*l.* 0*s.* 5*d.* 13*l.* 17*s.* 9*d.* 70*l.* 5*s.* 10*d.*
25*l.* 13*s.* 9*d.* 63*l.* 6*s.* 8*d.* 99*l.* 5*s.* 6*d.* 86*l.* 1*s.* 8*d.*
62*l.* 10*s.* 0*d.* 167*l.* 4*s.* 0*d.* 286*l.* 3*s.* 4*d.* 375*l.* 0*s.* 0*d.*

Articles including Shillings and Pence. Page 127.

8*l.* 19*s.* 11*d.* 26*l.* 0*s.* 10*d.* 98*l.* 7*s.* 6*d.* 255*l.* 16*s.* 5*d.*
246*l.* 3*s.* 5*d.* 162*l.* 3*s.* 0*d.* 40*l.* 5*s.* 0*d.* 582*l.* 18*s.* 0*d.*
894*l.* 5*s.* 10*d.* 1067*l.* 13*s.* 3*d.* 1344*l.* 12*s.* 11*d.* 2497*l.* 15*s.* 7½*d.*

To remove Fractions. Page 128.

2*l.* 6*s.* 6*d.* 40*l.* 13*s.* 0*d.* 72*l.* 18*s.* 0*d.*
8*l.* 8*s.* 0*d.* 178*l.* 10*s.* 0*d.* 45*l.* 10*s.* 2¼ ¾*d.*
31*l.* 19*s.* 0*d.* 128*l.* 10*s.* 0*d.* 204*l.* 0*s.* 0¾ ¾*d.*

One Year's Interest. Page 128.

9*s.* 7¾*d.* 1*l.* 6*s.* 2¾*d.* + 2*l.* 10*s.* 0*d.* 10*l.* 11*s.* 6*d.*
4*l.* 13*s.* 7*d.* + 8*l.* 14*s.* 6½*d.* + 17*l.* 10*s.* 3*d.* 900*l.* 7*s.* 10*d.*

Interest for Months at 5 *per Cent.* Page 129.

1*l.* 5*s.* 4*l.* 13*s.* 4*d.* 8*l.* 17*s.* 7½*d.* 13*l.* 10*s.* 11¼*d.*
45*l.* 15*s.* 2*d.* 188*l.* 7*s.* 1*d.*

Interest for Days. Page 129.

2¼*d.* 2*s.* 8*d.* 4*s.* 2*s.* 11¼*d.* 9*s.* 1¾*d.*
2*l.* 2*s.* 4*d.* 1*l.* 12*s.* 10½*d.* 4*l.* 8*s.* 9*d.*

Interest for Months at 6 *per Cent.* Page 130.

4*s.* 6*d.* 1*l.* 3*l.* 20*l.* 8*s.* 50*l.* 7*l.* 17*s.* 6*d.*
4*l.* 12*s.* 6*d.* 3*l.* 14*s.* 20*l.* 175*l.*

Interest for Months at 4 *per Cent.* Page 130.

2*l.* 5*l.* 16*s.* 8*d.* 5*l.* 6*l.* 13*s.* 4*d.* 12*l.* 3*s.* 0¼*d.*
24*l.* 19*s.* 31*l.* 13*s.* 4*d.* 44*l.*

Interest for Months at 3 *per Cent.*—4*s.* 1¼*d.* 18*s.* 0½*d.* 4*l.* 17*s.* 0½*d.*

Interest for Months at 2 *per Cent.* 12*s.* 2¼*d.* 2*s.* 11*d.*
3*l.* 18*s.* 6¼*d.*

Interest at Halves per Cent. Page 131.

5*l.* 8*l.* 18*s.* 9*l.* 19*s.* 11¼*d.* 23*l.* 15*s.* 3*d.* 66*l.* 26*l.* 6*s.* 9¾*d.*
12*s.* 2*s.* 6*d.* 3*l.* 7*l.* 14*s.* 7*d.* 1*l.* 5*s.* 18*l.* 15*s.*

Interest for any Time at any Rate. Page 131.

2*s.* 0¾*d.* 10*s.* 3*d.* 17*s.* 10¾*d.* 28*l.* 12*s.* 0¼*d.*
11*l.* 11*s.* 7½*d.* 51*l.* 1*s.* 10¾*d.*

Interest for any Sum, for any Time, at any Rate per Cent. P. 132

1*l.* 3*s.* 2¾*d.* 9*l.* 11*s.* 4*d.* 2*l.* 7*s.* 1*d.* 26*l.* 8*s.* 4½*d.*
134*l.* 16*s.* 11¼*d.* 937*l.* 8*s.* 10½*d.*

ANSWERS TO THE MISCELLANEOUS QUESTIONS ON MENTAL ARITHMETIC.

1 *Ans.* 2.
2 10.
3 $\frac{1}{2}$.
4 3 miles.
5 192.
6 15*l.*
7 11*l.* 8*s.*
8 64.
9 8.
10 All equai.
11 2 qrs.
12 1*s.*
13 7.
14 1.
15 176 minutes, or 2 hours 56 minutes.
16 19*d.*
17 54; 85.
18 130; 151.
19 12.
20 1*l.* 5*s.*
21 25; 54.
22 $6\frac{1}{4}$; $10\frac{1}{5}$.
23 5*l.*
24 40 feet.
25 40 minutes.
26 16*s.* 8*d.*
27 10; 10; 22; 12.
28 25 of each.
29 5280.
30 $233\frac{1}{4}$; 437; 1300; $2443\frac{1}{2}$; $753\frac{1}{4}$.
31 60.
32 $33\frac{1}{3}$.
33 $11\frac{1}{4}d.$; 1*s.* $4\frac{3}{4}d$; 5*s.* 3*d.*
34 4*s.*; 1*s.* 3*d.*; 10*s.* $7\frac{3}{4}d.$
35 10*s.* 8*d.*; 1*l.* 16*s.* 0*d.*; 5*l.* 16*s.* 8*d.*
36 *Ans.* 1*l.* 13*s.* 4*d.*; 1*l.* 7*s.* 0*d.*; 7*l.* 12*s.*
37 192 E. ells, 160 Fr. ells, 320 Fl. ells.
38 792.
39 7*s.*; 1*l.* 11*s.* 3*d.*; 5*l.* 15*s.* 6*d.*
40 4*l.* 4*s.*; 13*l.* 4*s.*; 40*l.* 10*s.*
41 1*l.* 5*s.* $10\frac{1}{4}d.$; 3*l.* 0*s.* $7\frac{1}{2}d.$ 3*l.* 0*s.* 11*d.*
42 10*s.* 9*d.*
43 5*l.* 1*s.* 3*d.*; 6*l.* 3*s.* 2*d.*; 36*l.* 17*s.* 11*d.*
44 1*l.* 6*s.*
45 17*l.* 2*s.* 6*d.*; 19*l.* 6*s.* 8*d.*; 178*l.* 5*s.*; 75*l.*
46 1*l.* 4*s.*
47 97*l.* 10*s.*
48 4*l.* 6*s.*; 12*l.* 15*s.*; 17*l.* 11*s.* 9*d.*; 39*l.* 3*s.*
49 1200.
50 2.
51 12.
52 216.
53 5.
54 9.
55 15.
56 27.
57 13*l.* 18*s.* 3*d.*
58 4*l.* 11*s.* 3*d.*
59 4*l.* 1*s.* 8*d.*; 4*l.* 8*s.* 8*d.*; 5*l.* 14*s.* 4*d.*
60 9*l.* 6*s.* 8*d.*; 14*l.*; 11*l.* 11*s*
61 7*l.* 4*s.* $5\frac{3}{4}d.$
62 5832; 6150; 6205; 23826.
63 30 hours; 300; 180.
64 1*l.* 1*s.* $10\frac{1}{2}d.$; 1*l.* 14*s.* $10\frac{1}{2}d.$; 2*l.* 8*s.* $6\frac{3}{4}d.$

65 *Ans.* 350*l.* 2*s.* 11*d.*; 85*l.* 10*s.*
66 13*l.* 15*s.*; 111*l.* 6*s.* 2*d.*
67 39*l.* 16*s.* 8*d.*; 100*l.* 5*s.* 10*d.*; 19*l.* 5*s.*
68 3*l.* 17*s.*; 3*l.* 12*s.* 4*d.*; 4*l.* 6*s.* 4*d.*; 4*l.* 18*s.*; 5*l.* 9*s.* 8*d.*
69 13*s.* 6*d.*; 25*l.*
70 32.
71 22*l.* 10*s.*; 12*s.* 6*d.*
72 $\frac{1}{4}d.$
·5 6″
·5 6″
·25 = $\frac{1}{4}$ 36‴ = $\frac{1}{4}$ of 1*d.*
73 362880.
74 4*s.* 9*d.* +
75 1*l.* 0*s.* 10*d.*; 4*l.* 17*s.* 11*d.* 12*l.* 14*s.* 2*d.*
76 3*l.* 10*s.*
77 Lose 1*l.* 3*s.* 4*d.*
78 200*l.* 10*s.*; 102*l.* 0*s.* 7½*d.* 302*l.* 4*s.* 2*d.*
79 311*l.* 1*s.* 3*d.*; 62*l.* 8*s.* 8*d.*; 4310*l.*
80 330*l.* 10*s.*; 1424*l.* 3*s.* 4*d.*; 2500*l.* 13*s.* 4*d.*
81 1250*l.* 4*s.*; 2300*l.* 15*s.*; 640*l.* 13*s.* 4*d.*
82 631*l.* 4*s.*; 2164*l.* 16*s.*; 3672*l.* 10*s.*
83 5046*l.* 12*s.*; 4761*l.* 8*s.*; 1806*l.*
84 16; 49; 100; 256; 400.
85 27; 216; 729; 1000; 1728.
86 16; 625; 1296; 4096; 10,000.
87 1; 32; 243; 1024; 3125.
88 9; 10; 8; 11; 12.
89 2; 3; 5; 7; 12.
90 2; 7; 9; 22.
91 2; 3; 8; 10.
92 *Ans.* 150 men.
93 16*l.* 6*s.* 8*d.*
94 1*l.* 13*s.*
95 84*l.*
96 3220 lbs.
97 5*l.* 4*s.* 2*d.*; 92*l.* 3*s.* 3*d.*; 170*l.* 2*s.* 3¾*d.*; 19*s.* 9*d.*; 42*l.* 5*s.* 3½*d.*; 229*l.* 3*s.* 4*d.*
98 2*l.* 8*s.*; 1*l.* 5*s.* 7¾*d.*; 35*l.* 6*s.* 3¼*d.*; 6*l.* 4*s.*; 5*l.* 11*s.* 145*l.* 5*s.* 7¾*d.*
99 3*s.* 6*d.*; 8*s.* 4¾*d.*; 11*s.* 6½*d.*; 4*l.* 15*s.* 0¾*d.*
100 1*l.* 13*s.* 2½*d.*; 13*l.* 10*s.*; 1*l.* 15*s.*
101 6*s.* 9½*d.*; 18*s.* 6¼*d.*; 8*l.* 14*s.* 4¾*d.*; 36*l.*
102 3*s.* 6½*d.*; 18*s.* 2¼*d.*; 5*l.* 9*s.* 0½*d.*; 4*s.* 11¼*d.*
103 2*s.* 0¼*d.*; 17*s.* 1*d.*; 18*s.* 11½*d.*; 6*l.* 1*s.* 4¾*d.*
104 112*l.*; 17*l.* 10*s.*
105 42*l.*; 4918*l.*; 17*s.* 5*d.*
106 379*l.* 16*s.* 10¼*d.*; 311*l.* 3*s.* 4*d.*
107 315*l.* 5*s.* 2*d.*; 800*l.*
108 ·626*l.*
109 16*s.* 8½*d.*; 5*d.*
110 2 qrs. 13 lbs. 3 oz. 7 drs. 10 cwts. 1 qr. 16 lbs. 12 oz. 12 drs.; 14 oz. 6 drs.
111 $1\frac{1}{9}$; $1\frac{7}{125}$; $\frac{200}{576}$.
112 ·5; ·625; ·75; ·416+; ·181+; ·3; 2·5.
113 $\frac{62}{960}$; $\frac{101}{900}$; $\frac{195}{240}$; $\frac{237}{960}$.
114 19*s.* 7*d.*
115 4*l.* 9*s.* 4½*d.*
116 360.
117 31*l.* 4*s.*
118 1200.
119 57*l.* 15*s.*
120 16.
121 *Ans.* 2¼.
122 5.
123 24.

QUESTIONS

ON

THE FRACTOGRAPH.

Find on Square 1.	*Find on Square* 2.
$\frac{1}{2}$. $\frac{1}{4}$. $\frac{1}{8}$. $\frac{1}{16}$. $\frac{1}{32}$.	$\frac{1}{9}$. $\frac{1}{3}$. $\frac{1}{18}$. $\frac{1}{72}$. $\frac{1}{144}$.
$\frac{1}{2}$ of $\frac{1}{4}$. $\frac{3}{4}$ of $\frac{1}{4}$.	$\frac{1}{4}$ of $\frac{1}{9}$. $\frac{1}{8}$ of $\frac{1}{9}$.
$\frac{1}{3}$ of $\frac{1}{2}$ of $\frac{1}{4}$ of $\frac{1}{4}$.	$\frac{1}{144}$ of $\frac{1}{9}$ of 1.
Find on Square 3.	*Find on Square* 4.
$\frac{1}{16}$. $\frac{1}{32}$. $\frac{1}{64}$. $\frac{1}{128}$. $\frac{1}{256}$.	$\frac{1}{12}$. $\frac{1}{24}$. $\frac{1}{96}$. $\frac{1}{108}$. $\frac{1}{432}$.
$\frac{1}{4}$ of $\frac{1}{16}$. $\frac{1}{16}$ of $\frac{1}{16}$.	$\frac{1}{4}$ of $\frac{1}{12}$. $\frac{3}{8}$ of $\frac{1}{12}$.
$\frac{1}{4}$ of $\frac{1}{4}$ of $\frac{1}{16}$.	$\frac{1}{8}$ of $\frac{1}{9}$ of $\frac{1}{12}$.

Questions on Square 1,
as a Pound Sterling.

What proportion of the square is 10 shillings?
5*s.*? 2*s.* 6*d.*? 1*s.* 3*d.*
7½*d.*? 3¾*d.*?
7*s.* 6*d.*? 15*s.* 0*d.*? 17*s.* 6*d.*?
6*s.* 3*d.*? 3*s.* 9*d.*? 11¼*d.*

What is the value of
$\frac{1}{8}$ of $\frac{1}{4}$ of 1*l.*? $\frac{3}{4}$ of $\frac{1}{2}$ of 1*l.*?

Add
$\frac{1}{4}$ of $\frac{1}{2}$ of 1*l.* to $\frac{1}{8}$ of 1*l.*?
$\frac{1}{4}$ of $\frac{1}{4}$ of 1*l.* to $\frac{3}{4}$ of 1*l.*?

Subtract
$\frac{3}{8}$ of $\frac{1}{4}$ of 1*l.* from $\frac{1}{16}$ of 1*l.*?
$\frac{1}{8}$ of $\frac{1}{2}$ of 1*l.* from $\frac{3}{4}$ of 1*l.*?

Questions on Square 2,
as a Square Yard.

What proportion of the square is 1 square foot?
$\frac{1}{4}$ of 1 square foot? 1 inch?
3 square feet? 6 square feet?
12 sq. inches? 36 sq. inches?
72 sq. inches? 108 sq. inches?

What is the value of
$\frac{1}{2}$ of $\frac{1}{9}$ of 1 ft.? $\frac{1}{144}$ of $\frac{1}{9}$ of 1 ft.?

What proportion of a yard is
1 foot? 1 inch? ¼ foot?
12 ins.? 48 ins.? 72 ins.?
108 ins.? 1½ foot? 3 feet?
½ and ¼ foot? ¼ ft. and 36 in.?
2 ft. and 36 in.? 4 ft. and 72 in.

Questions on Square 3, as a Pound Avoirdupois.

What proportion of the square is 1 ounce? ½ of 1 oz.? ¼ of 1 oz.? 1 dram? 4 drams?

What is the value of ¼ of $\frac{1}{16}$ of 1 lb.? $\frac{1}{16}$ of $\frac{1}{16}$ of 1 lb?

What proportion of 1 lb. is
1 dram? 8 drams?
12 ounces? ¼ of 1 ounce?
⅜ of 1 oz.? 1 oz. and 8 drs.?
½ & ¼ of 1 oz.? 5 oz. & 8 drs.?
1 oz., ⅜ oz., ¼ oz., and 6 drs.?

Questions on Square 4, as a Butt.

What proportion of the square is 1 firkin? 1 gallon? 1 quart? 1 pint? 1 barrel? 1 kilderkin? 1 hogshead?

What is the value of ⅑ of ½ of 1 butt? ½ of ¼ of $\frac{1}{12}$?

What proportion of a butt is 1 gallon? 1 quart? 1 pint? 3 firkins? 2 kild.? 1½ barrs.? 1 firkin, 4 gallons, and 2 quarts. 2 kilds., 3½ firkins, & 4½ galls.?

Questions on the whole Fractograph.

Add together
½ of ¼, ¼ of ¼, ¾ of ¼ of ¼, and ⅔ of ¼ of ¼?
¼, $\frac{9}{16}$ of ¼, ¼ of ¼, ⅛ of ¼, ⅛ of $\frac{1}{16}$ of ¼, and $\frac{1}{16}$ of $\frac{1}{16}$ of ¼?
½, ⅝ of ¼, ⅓ of ¼, ⅔ of ⅑ of ¼, and $\frac{36}{144}$ of ¼?
¾, $\frac{7}{12}$ of ¼, ¼ of ¼, ⅝ of $\frac{1}{12}$ of ¼, ⅑ of $\frac{1}{12}$ of ¼, and ⅜ of $\frac{1}{12}$ of ¼?

Subtract from ¼
⅜ of ½ of ¼, ¼ of ⅛ of 2, ¼ of ½ of ⅓ of ¼?

From ½
⅛ of ¼, ⅔ of ⅛ of ¼, ½ of $\frac{2}{16}$ of ¼, $\frac{4}{16}$ of ¼, ½ of $\frac{3}{16}$ of ¼, $\frac{8}{16}$ of $\frac{1}{16}$ of ¼?

From ⅜
⅛ of ¼, ¾ of ¼, $\frac{10}{16}$ of ¼, ¼ of $\frac{12}{16}$ of ¼, ¾ of $\frac{1}{16}$ of ¼, $\frac{24}{16}$ of ¼, ⅛ of ¼?

From the whole Fractograph
$\frac{1}{2}$ of ¼, $\frac{4}{16}$ of ¼, ½ of ⅔ of ¼, ⅔ of ¼, $\frac{9}{12}$ of ¼, $\frac{4}{16}$ of ¼, ½ of $\frac{1}{9}$ of ¼?

What proportion of the fractograph is broken off by the line across squares 1 and 2?
What parts are separated by the fracture of squares 1 and 3?
What part is cut off by the line through squares 3 and 4?
What proportion is broken off by the line from 2 to 4?

J. & W. RIDER, Printers, 14, Bartholomew Close, London, E.C.